ATTACHMENT D - Effluent Limitations

1. Excerpts from the 2004 VPDES Permit Modification Fact Sheet Amendment #1, regarding "Process Wastewater Effluent Limitations and Dissolved Oxygen Levels in the Jackson River"
   a. Narrative from Fact Sheet Amendment #1 – pages 1 &2 regarding BOD_5 & temperature limits and modeled Jackson River dissolved oxygen levels.
   b. 6/6/03 memo from Thomas W. Gallagher of HydroQual to Tim Morse, (Mead)Westvaco on "Derivation of Effluent BOD5 from the Time Variable Models"
   c. 9/5/03 memo from Ed J. Garland of HydroQual to Tim Morse, MeadWestvaco on "Evaluation of Compliance with Jackson River DO Standards for the Months of Nov. - May"

2. MSTRANTI (draft 2b) Feb. 2012 Waste Load Allocation spreadsheet outfall 003.

3. STATS.exe statistical analysis desktop software printout for outfall 003 evaluation of ammonia using a year of weekly data points from permittee; STATS.exe outputs of Arsenic, Chromium III, Copper, Lead & Nickel.

4. Support background information from permittee on 316a temperature variance.

5. Support to Water Quality Based Color Limit as brought forward from 2002 reissuance;
   a. Cover & excerpt from 1st Annual Report to State Water Control Board, dated 4/25/72, Treatability Study on removal of color from effluent of the Covington Mill and instream color values from that time.
   b. Cover & Table 3-9 from the Effects of Color and Solids on the Depth of Compensation and Primary Productivity in the Jackson River, Virginia, dated 4/90.
   c. Cover & Figure 5 from the Update on the Jackson River Dissolved Oxygen Model, dated 5/24/91.

FACT SHEET AMENDMENT #1

M E M O R A N D U M
DEPARTMENT OF ENVIRONMENTAL QUALITY
WEST CENTRAL REGIONAL OFFICE
WATER DIVISION

3019 Peters Creek Road **Roanoke, Virginia 24019-2738**

Subject: Fact Sheet Amendment #1 - Modification of VPDES Permit **VA0003646**
MeadWestvaco of Virginia Corporation, Covington Mill

To: FACT SHEET

From: Susan K. Edwards, Environmental Engineer, Sr. **Date:** February 12, 2004

MODIFICATION RATIONALE:

A. Process Wastewater Effluent Limitations and Dissolved Oxygen Levels in the Jackson River:

Under a Special Order by Consent, between VaDEQ and MeadWestvaco Corp., a time-variable model has been developed of the Jackson River. The Jackson River Periphyton Model, prepared by HydroQual Environmental Engineers & Scientists, evaluates the assimilative capacity of the Jackson River and predicts dissolved oxygen (DO) levels downstream of the mill's discharges. The model report was originally submitted on December 2, 2002 and reissued in June 2003 to include additional information at the request of DEQ. The latest version of the model report titled Development and Calibration of the Jackson River Periphyton Model, has been reviewed by DEQ staff and is attached to this Fact Sheet Amendment in support of process wastewater effluent limitations for discharge from the mill, outfall 003.

The model report documents the breadth of effort made in development of this tool that is the basis of 5-day Biological Oxygen Demand (BOD_5) and Temperature limitations in this VPDES permit modification. The model also predicts the effect of elimination of heat load discharges of non-contact cooling water, an effluent oxygenation system and effluent nutrient levels on river DO. The Covington wastewater treatment plant discharge is included within the modeled river segments. The model evaluates conditions during the critical months for assimilative capacity in river flow and temperature - June through October.

Section 9 VAC 25-31-220 D.1.b of the VPDES Permit Regulations states: "When determining whether a discharge causes, has the reasonable potential to cause, an in-stream excursion above (below) a narrative or numeric criteria within a Virginia water quality standard, the Board shall use procedures which account for … the variability of the pollutant or pollutant parameters in the effluent, … , and where appropriate the dilution of the effluent in the receiving stream." *(Emphasis added.)* This "time-variable" model presents a unique depiction of the Jackson River's response to the impact of this industrial discharge as compared to other modeling tools available for use in establishing VPDES effluent limitations. This model is specifically directed at the complex dynamics that cause or contribute to dissolved oxygen levels near the instream standard. The model is not intended to address the existing General Standard impairment noted as "benthic impairment" on the 2002 303(d) Total Maximum Daily Load (TMDL) Priority List. Nor has the model been used at this time to fully evaluate nutrients in this segment. The TMDL to address these issues is listed for 2010 completion, nutrient standards work is ongoing within DEQ and the river is also within the Chesapeake Bay Tributary Strategy efforts.

Section 6 of the model report presents several Projection Analyses that were performed on the calibrated model. These projections represent the probable number of DO violations that would occur in a 5-year permit term based on 20 5-month summers. The simulations were developed for 3 different monthly-average BOD_5 effluent limitations and 10 combinations of conditions. The 10 simulations reflect including or excluding four key components in a given model run - heat load from outfalls 001 and 002, use of the effluent oxygenation system, reduction of effluent nitrogen and reduction of effluent phosphorus. The predictions facilitate the setting of a combination of effluent limitations needed to maintain the instream DO standards of 5.0 mg/l daily average and 4.0 mg/l as a daily minimum. A copy Figure 6-9 of the Report representing the results of the simulations is enclosed as an attachment to this Fact Sheet Amendment.

Effluent limits are based on the projection analysis represented by the top panel of the model report Figure 6-9b. This panel indicates with the elimination of the heat loads from outfalls 001 and 002, existing effluent nutrient levels, **monthly average BOD_5** limit of **7000 pounds/day (3175 kg/day)** and normal releases from the Gathright Dam there will be no violations of the instream DO standard. This representation of the model projection does not include the use of the effluent oxygenation or down stream/side stream oxygenation system. Therefore, from June through October these systems should only be needed to achieve the water quality standards for DO if a spill, upset or condition outside the control of the permittee occurs. The model does predict certain instances when the level of dissolved oxygen could approach the instream DO standard. Therefore, the permit includes terms that are to be followed by the permittee regarding the use of oxygen to provide some margin of safety with respect to the instream dissolved oxygen standard (see item B. below).

A June 6, 2003 memorandum from HydroQual was submitted in support of the establishing effluent limits from the model BOD_5 levels. A copy of the HydroQual memo has been attached to this Fact Sheet Amendment. The June 6 memo addressed the use of the Jackson River Periphyton model to establish both monthly average and daily maximum BOD_5 limits for the tier of June through October. The distribution of the monthly average limit of 7000 pounds/day corresponds to a daily maximum of 18,813 pounds/day. However, rather than using this model value, the **daily maximum** is set at the level of the current VPDES Permit and Consent Order of **8390 kg/day (18,500 pounds/day)**. The model supports a slightly higher daily maximum limitation than the limit in the permit. However, the permittee has agreed to accept the current limitation. Maintenance of this daily maximum limit increases the probability of compliance with the instream DO standard.

The Jackson River Periphyton Model focuses on critical conditions in the River that are most likely to occur between June and October. During the other seven months of the year flow as controlled by releases from the Gathright Dam are higher and river temperatures cooler. A September 5, 2003 HydroQual memorandum addresses BOD_5 limits for the other seven months of the year, November through May. The memo states that a simplified model of the assimilative capacity of the Jackson River supports the higher tiered **monthly average** value of the 1994 and 2002 VPDES permits of **9240 pounds/day (4195 kg/day)**. The **daily maximum** value of **8390 kg/day (18,500 pounds/day)** is continued throughout the year. A copy of the HydroQual memo is attached.

B. <u>Jackson River Dissolved Oxygen Levels</u>: A special condition has been added to the permit pertaining to the use of the effluent and side stream oxygenation systems. The condition, Part I.C.11 established how river oxygen levels will be monitored, when the systems are used and the associated monitoring and reporting. The condition requires use of the effluent system when in-river conditions indicate DO levels may be reaching undesirable levels. Reporting of oxygenation system use and related effluent and river conditions can be compared with the projected need to use oxygenation by the Jackson River Periphyton Model.

C. <u>Whole Effluent Toxicity</u>: Please see the attached memorandum on removal of pending WET limit. The permit special condition has been revised to require annual monitoring in accordance with Guidance Memo #00-2012. This change effects the effluent limit pages pertaining to the wastewater treatment plant outfall 003 and the special condition of Part I.C.12.

MEMORANDUM

TO: TIM MORSE

DATE: JUNE 6, 2003

RE: DERIVATIVE OF EFFLUENT BOD_5 FROM TIME VARIABLE MODELS

FROM: THOMAS W. GALLAGHER

FILE: WEST0092

The time-variable model of the Jackson River represents the day to day variability in Westvaco's effluent BOD_5 in the calculation of river daily average and daily minimum river dissolved oxygen levels for a twenty year simulation. The daily and monthly average BOD_5 distributions shown in Figures 1a and 1b are the distributions that achieve compliance with the daily average and minimum dissolved oxygen standards of 5.0 mg/l and 4.0 mg/l in the twenty year simulation. This memorandum addresses the issues in writing BOD_5 permit limits based on these BOD_5 distributions.

From a purely scientific perspective there are a variety of methods for describing these BOD_5 distributions including the median and coefficient of variation or a certain percentile with the corresponding acceptable number of exceedances per permit cycle. For example, one approach for developing a monthly limit would be to select a 95 percentile BOD_5 load of 5706 lb/day and set that as the permit limit with the specification that Westvaco could exceed 5706 lb/day 5% of the time (3 months per 60 month permit cycle) and not be in violation of its permit limit. Although this is scientifically appropriate it creates practical issues for enforcement of these permit limits. The principal problem is that compliance with permit limits can not be evaluated on a month to month basis and must be defined for a period varying from months to the entire 5 year permit cycle.

An alternative to waiting many months to judge compliance with permit limits is to select a BOD_5 value from the distribution that can be viewed as a never to exceed number. This approach allows the regulatory agencies to continue to evaluate permit compliance on a month by month basis as is currently the practice. The question then becomes what percentile to select from the effluent BOD_5 distribution that would be acceptable as a never to exceed permit limit. Certainly a 95 percentile monthly BOD_5 limit with an expected exceedance frequency of 3 months for a 5 year permit cycle is unacceptable. A reasonable approach might be to select a 99 percentile of 7000 lb/day from Figure 1a as the monthly limit which has an expected exceedance of 1 in a 100 months or once every 1.67 permit cycles or less than once per 5 year permit cycle. It should be emphasized that the assignment of any percentile from the effluent monthly BOD_5 distribution does not change the fact that river dissolved oxygen standards are met with this BOD_5 distribution in the time variable model simulations. Selecting the 99 percentile monthly BOD_5 would reduce the chance of falsely being considered in violation of the permit.

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The corresponding daily BOD_5 limit could be developed on the basis of maintaining the same risk level used in the derivation of the monthly limit which is one exceedance every 1.67 permit cycles. One daily exceedance over 1.67 permit cycles would be one day in 3048 days (1.67 x 1825 days/permit cycle) or 99.97 percentile. From Figure 1b this corresponds to a daily BOD_5 limit of 18,813 lb/day. As a consequence of applying the same procedure used in the assignment of the monthly BOD_5 limit, there is the same low chance of falsely being considered in violation of the daily BOD_5 permit limit.

TWG/lkj
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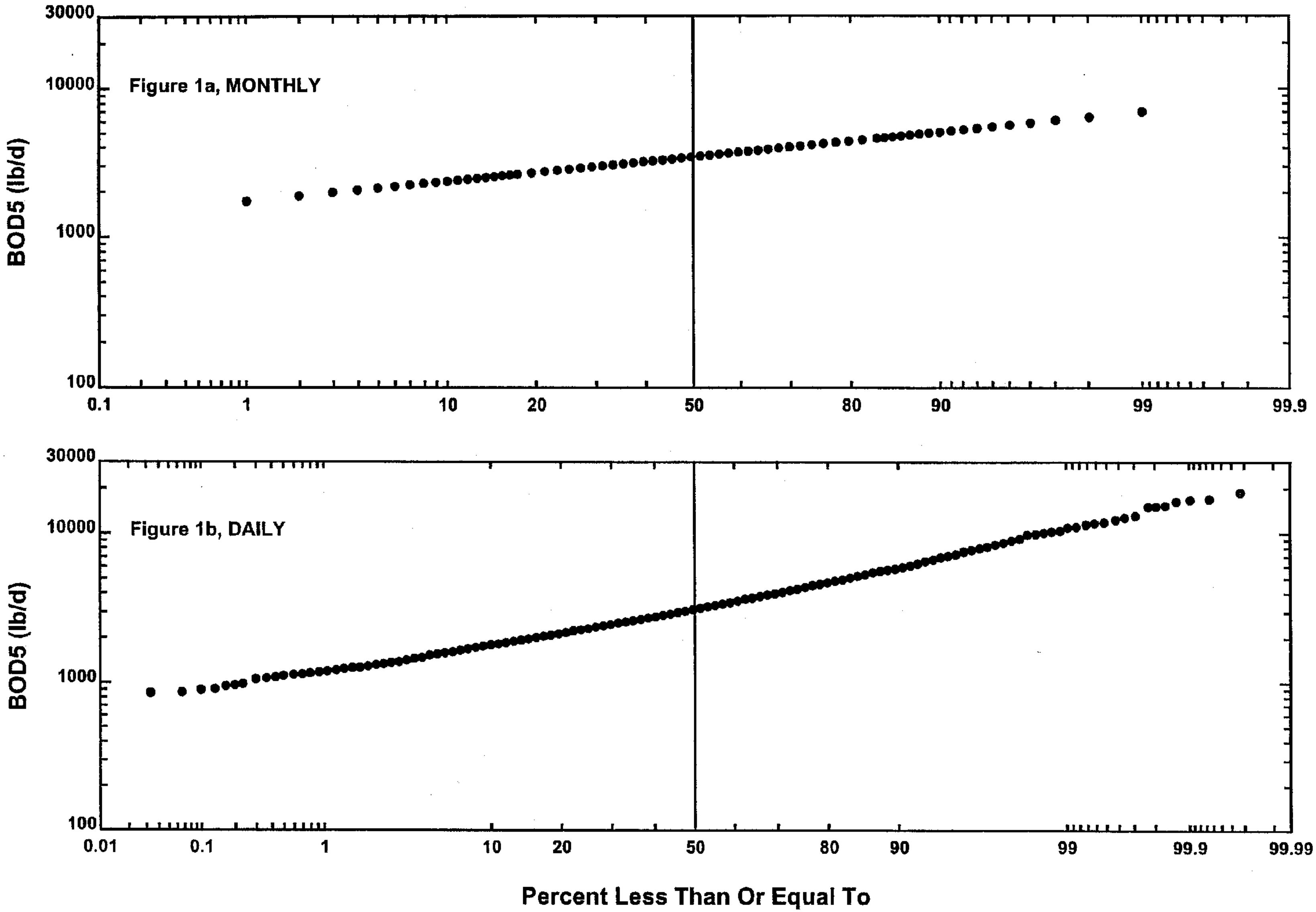

Westvaco Effluent BOD_5 Distribution

MEMORANDUM

TO: TIM MORSE

DATE: SEPTEMBER 5, 2003

RE: EVALUATION OF COMPLIANCE WITH JACKSON RIVER DISSOLVED OXYGEN STANDARDS FOR THE MONTHS OF NOVEMBER THROUGH MAY

FROM: E. J. GARLAND

FILE: WEST0092

HydroQual's Report, "Development and Calibration of the Jackson River Periphyton Model" (June, 2003) described the model calibration for the months of June through October. Warmer water temperatures in these months make this time period more critical with respect to dissolved oxygen. Focused data collection efforts provided extensive data for model calibration for the June through October period. HydroQual's June 2003 report includes an analysis of the frequency of compliance with dissolved oxygen standards under a wide range of effluent loading conditions for the months of June through October. This note summarizes the evaluation of effluent BOD loadings that produce compliance with dissolved oxygen standards for the remaining months of the year, November through May.

The assimilative capacity of the Jackson River is greater during the November through May period compared to June through October. Anti-backsliding regulations, however, constrain the maximum effluent permit limit to the existing limit of 9240 lb/d. The constraint imposed by anti-backsliding represents a factor of safety when compared to the actual assimilative capacity. In light of this, the evaluation of instream dissolved oxygen conditions in the November through May period was performed with several conservative assumptions that allow the analysis to be simplified. Rather than develop model inputs to describe hourly variations in river temperature, 90th percentile temperatures were used and kept constant throughout a given month. Tenth percentile flows were used and kept constant throughout a given month rather than apply CE-QUAL-RIV1 with a historical hydrograph. The 10th percentile flows were less than the guaranteed minimum flows in six out of the 7 months. Solar radiation was varied from month to month, however within a given month it was assigned by developing hourly variations for an average day. For each hour of the average day, solar radiation data from 1998 through 2002 were averaged. Boundary conditions and nutrient loads were assigned temporally constant, at average values.

Because algal kinetics were not calibrated for the winter months, a conservative assumption was made to incorporate algal effects on dissolved oxygen in these simulations. Initial conditions for algal biomass were assigned based on available data from the end of October and beginning of November. A decline in algal biomass levels was computed during the month of November in response to the cooler water temperature and reduced solar radiation. Algal biomass data collected during the months of December through March were too limited to use assess computed temporal changes in algal biomass levels. Instead, algal biomass computed at the end of November was used as the initial condition for December and the algal system bypass flag was switched to prevent the biomass concentrations from changing during the course of the simulation. Even though the available light and temperature conditions would result in a computed decline in biomass levels, the initial conditions were maintained throughout the months of December through March. Although algal biomass data collected during the April and May are also too sparse to use to evaluate computed temporal changes in biomass levels, these limited data indicate higher biomass levels than the constant conditions used throughout the December to March period. The limited data from April and May were used to assign initial conditions at the beginning of April and kept constant through these two months. This approach overstates the biomass level in the winter months and produces diurnal fluctuations that are greater than would be expected during these months. The exaggerated diurnal range in dissolved oxygen produces lower daily minimum dissolved oxygen concentrations than would be expected. Even if the daily minimum concentrations are computed lower than would be expected, the loading scenario is acceptable as long as the daily minimum concentrations are above 4 mg/l.

BOD loading was varied on a daily basis following the approach used for the May through October period which is described in the calibration report. The distribution of monthly average BOD loads from the 28 months of July 2000 through October 2002 was scaled up so that the 99th percentile value was 9240 lb/d. Monthly averages were then randomly selected and daily variations in BOD loads were developed by scaling the historical daily loads based on the ratio of the monthly average selected from the new distribution and the monthly average that had been measured historically in the months between November 2000 and May 2001.

Using this approach, no violations of the dissolved oxygen standards were calculated in the months of December through May. For the month of November, dissolved oxygen concentrations between 3.84 and 3.98 were computed in two segments on three days during the 20 years of simulations. Addition of 2,500 lb/d of oxygen through the effluent oxygenation system eliminated the calculation of dissolved oxygen concentrations below the 4 mg/l daily minimum standard in November. For the period of November through May, a distribution of monthly averages with a 99th percentile of 9240 lb/d produced no violations of the dissolved oxygen standard if 2500 lb/d of oxygen is added through the effluent oxygenation system during the month of November. Compliance with dissolved oxygen standards are achieved in the months of December through May without the need for oxygen addition.

EJG/lkj
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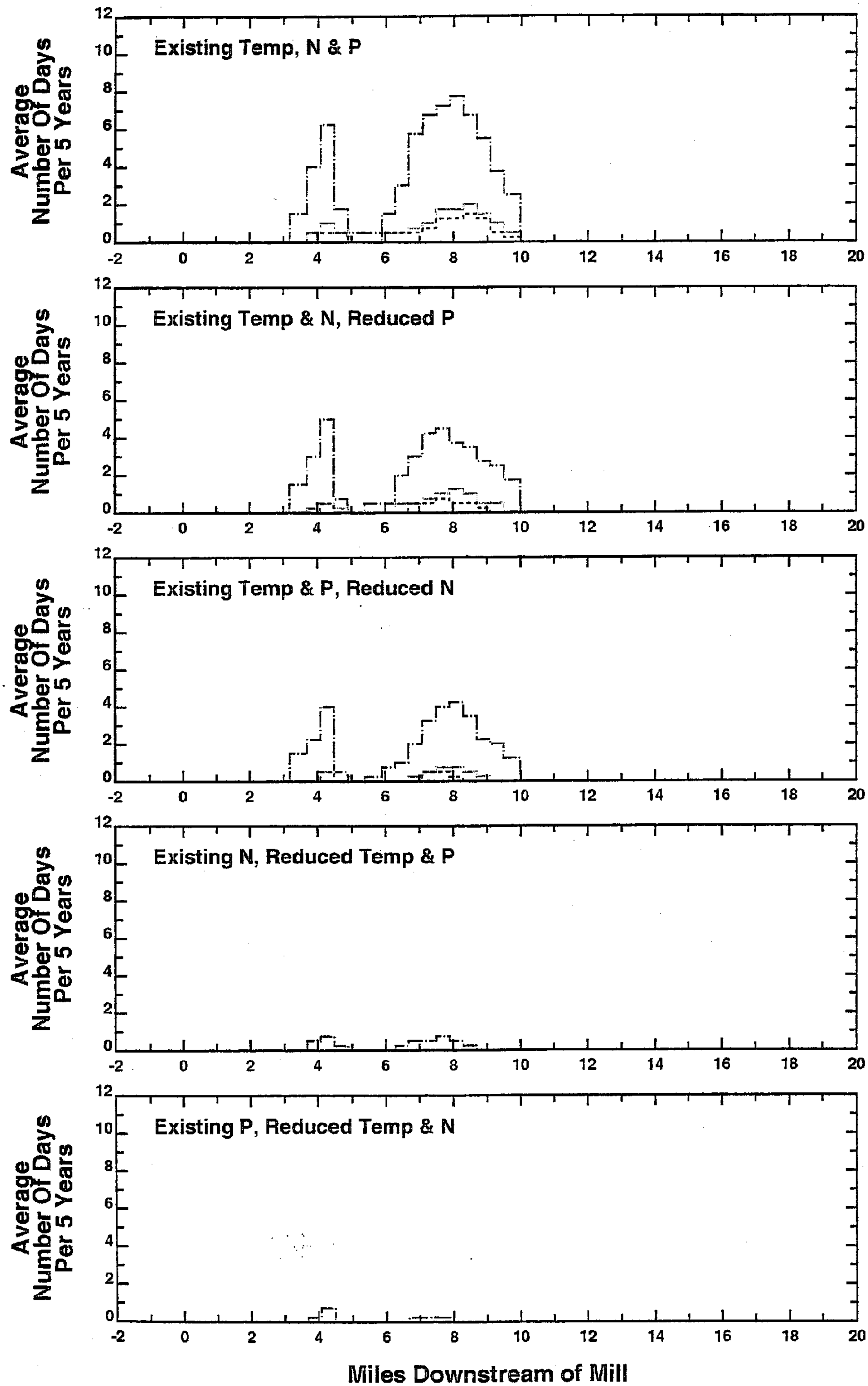

Figure 6-9a. Spatial Distribution of Days with Daily Minimum DO < 4 mg/l

99% = Consent Order Limit —·—· 99% = 7000 lb/d —— Existing Distribution — —

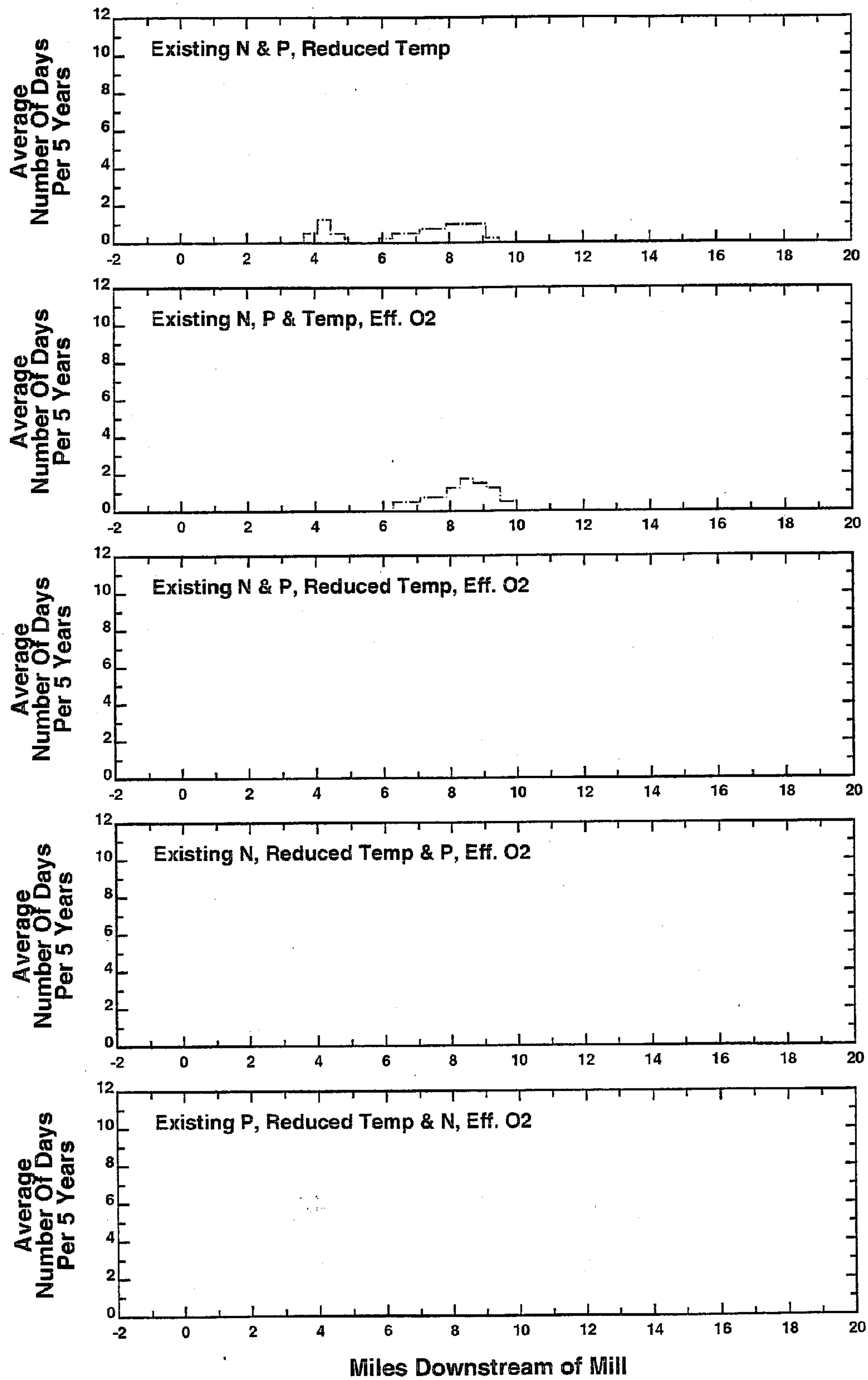

Figure 6-9b. Spatial Distribution of Days with Daily Minimum DO < 4 mg/l

99% = Consent Order Limit —·— 99% = 7000 lb/d —— Existing Distribution — —

FRESHWATER
WATER QUALITY CRITERIA / WASTELOAD ALLOCATION ANALYSIS

Facility Name: MeadWestvaco Covington

Permit No.: VA0003646

Receiving Stream: Jackson River

Version: OWP Guidance Memo 00-2011 (8/24/00)

Stream Information		
Mean Hardness (as CaCO3) =	73.7	mg/L
90% Temperature (Annual) =	17.7	deg C
90% Temperature (Wet season) =	18.3	deg C
90% Maximum pH =	8.1	SU
10% Maximum pH =	8.1	SU
Tier Designation (1 or 2) =	1	
Public Water Supply (PWS) Y/N? =	n	
Trout Present Y/N? =	n	
Early Life Stages Present Y/N? =	y	

Stream Flows		
1Q10 (Annual) =	63.2	MGD
7Q10 (Annual) =	63.2	MGD
30Q10 (Annual) =	63.2	MGD
1Q10 (Wet season) =	63.2	MGD
30Q10 (Wet season)	63.5	MGD
30Q5 =	63.2	MGD
Harmonic Mean =	63.2	MGD

Mixing Information		
Annual - 1Q10 Mix =	100	%
- 7Q10 Mix =	100	%
- 30Q10 Mix =	100	%
Wet Season - 1Q10 Mix =	100	%
- 30Q10 Mix =	100	%

Effluent Information		
Mean Hardness (as CaCO3) =	826	mg/L
90% Temp (Annual) =	37.7	deg C
90% Temp (Wet season) =	37.8	deg C
90% Maximum pH =	7.8	SU
10% Maximum pH =	7.8	SU
Discharge Flow =	35	MGD

Parameter	Background	Water Quality Criteria				Wasteload Allocations				Antidegradation Baseline				Antidegradation Allocations				**Most Limiting Allocations**			
(ug/l unless noted)	Conc.	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	**Acute**	**Chronic**	**HH (PWS)**	**HH**
Acenapthene	5	--	--	na	9.9E+02	--	--	na	2.8E+03	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**2.8E+03**
Acrolein	0	--	--	na	9.3E+00	--	--	na	2.6E+01	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**2.6E+01**
Acrylonitrile[C]	0	--	--	na	2.5E+00	--	--	na	7.0E+00	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**7.0E+00**
Aldrin [C]	0	3.0E+00	--	na	5.0E-04	8.4E+00	--	na	1.4E-03	--	--	--	--	--	--	--	--	**8.4E+00**	**--**	**na**	**1.4E-03**
Ammonia-N (mg/l) (Yearly)	0	8.93E+00	1.31E+00	na	--	2.50E+01	3.68E+00	na	--	--	--	--	--	--	--	--	--	**2.50E+01**	**3.68E+00**	**na**	**--**
Ammonia-N (mg/l) (High Flow)	0	8.93E+00	1.28E+00	na	--	2.50E+01	3.59E+00	na	--	--	--	--	--	--	--	--	--	**2.50E+01**	**3.59E+00**	**na**	**--**
Anthracene	0	--	--	na	4.0E+04	--	--	na	1.1E+05	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**1.1E+05**
Antimony	0	--	--	na	6.4E+02	--	--	na	1.8E+03	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**1.8E+03**
Arsenic	o	3.4E+02	1.5E+02	na	--	9.5E+02	4.2E+02	na	--	--	--	--	--	--	--	--	--	**9.5E+02**	**4.2E+02**	**na**	**--**
Barium	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**--**
Benzene [C]	0	--	--	na	5.1E+02	--	--	na	1.4E+03	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**1.4E+03**
Benzidine[C]	0	--	--	na	2.0E-03	--	--	na	5.6E-03	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**5.6E-03**
Benzo (a) anthracene [C]	0	--	--	na	1.8E-01	--	--	na	5.1E-01	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**5.1E-01**
Benzo (b) fluoranthene [C]	0	--	--	na	1.8E-01	--	--	na	5.1E-01	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**5.1E-01**
Benzo (k) fluoranthene [C]	0	--	--	na	1.8E-01	--	--	na	5.1E-01	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**5.1E-01**
Benzo (a) pyrene [C]	0	--	--	na	1.8E-01	--	--	na	5.1E-01	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**5.1E-01**
Bis2-Chloroethyl Ether [C]	0	--	--	na	5.3E+00	--	--	na	1.5E+01	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**1.5E+01**
Bis2-Chloroisopropyl Ether	0	--	--	na	6.5E+04	--	--	na	1.8E+05	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**1.8E+05**
Bis 2-Ethylhexyl Phthalate [C]	0	--	--	na	2.2E+01	--	--	na	6.2E+01	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**6.2E+01**
Bromoform [C]	0	--	--	na	1.4E+03	--	--	na	3.9E+03	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**3.9E+03**
Butylbenzylphthalate	0	--	--	na	1.9E+03	--	--	na	5.3E+03	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**5.3E+03**
Cadmium	0	1.6E+01	3.0E+00	na	--	4.4E+01	8.4E+00	na	--	--	--	--	--	--	--	--	--	**4.4E+01**	**8.4E+00**	**na**	**--**
Carbon Tetrachloride [C]	0	--	--	na	1.6E+01	--	--	na	4.5E+01	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**4.5E+01**
Chlordane [C]	0	2.4E+00	4.3E-03	na	8.1E-03	6.7E+00	1.2E-02	na	2.3E-02	--	--	--	--	--	--	--	--	**6.7E+00**	**1.2E-02**	**na**	**2.3E-02**
Chloride	0	8.6E+05	2.3E+05	na	--	2.4E+06	6.5E+05	na	--	--	--	--	--	--	--	--	--	**2.4E+06**	**6.5E+05**	**na**	**--**
TRC	0	1.9E+01	1.1E+01	na	--	5.3E+01	3.1E+01	na	--	--	--	--	--	--	--	--	--	**5.3E+01**	**3.1E+01**	**na**	**--**

Parameter	Background	Water Quality Criteria				Wasteload Allocations				Antidegradation Baseline				Antidegradation Allocations				**Most Limiting Allocations**			
(ug/l unless noted)	Conc.	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	**Acute**	**Chronic**	**HH (PWS)**	**HH**
Chlorobenzene	0	--	--	na	1.6E+03	--	--	na	4.5E+03	--	--	--	--	--	--	--	--	--	--	na	4.5E+03
Chlorodibromomethane[C]	0	--	--	na	1.3E+02	--	--	na	3.6E+02	--	--	--	--	--	--	--	--	--	--	na	3.6E+02
Chloroform	0	--	--	na	1.1E+04	--	--	na	3.1E+04	--	--	--	--	--	--	--	--	--	--	na	3.1E+04
2-Chloronaphthalene	0	--	--	na	1.6E+03	--	--	na	4.5E+03	--	--	--	--	--	--	--	--	--	--	na	4.5E+03
2-Chlorophenol	0	--	--	na	1.5E+02	--	--	na	4.2E+02	--	--	--	--	--	--	--	--	--	--	na	4.2E+02
Chlorpyrifos	0	8.3E-02	4.1E-02	na	--	2.3E-01	1.2E-01	na	--	--	--	--	--	--	--	--	--	2.3E-01	1.2E-01	na	--
Chromium III	0	1.6E+03	2.0E+02	na	--	4.4E+03	5.7E+02	na	--	--	--	--	--	--	--	--	--	4.4E+03	5.7E+02	na	--
Chromium VI	0	1.6E+01	1.1E+01	na	--	4.5E+01	3.1E+01	na	--	--	--	--	--	--	--	--	--	4.5E+01	3.1E+01	na	--
Chromium, Total	0	--	--	1.0E+02	--	--	--	na	--	--	--	--	--	--	--	--	--	--	--	na	--
Chrysene [C]	0	--	--	na	1.8E-02	--	--	na	5.1E-02	--	--	--	--	--	--	--	--	--	--	na	5.1E-02
Copper	0	4.3E+01	2.6E+01	na	--	1.2E+02	7.2E+01	na	--	--	--	--	--	--	--	--	--	1.2E+02	7.2E+01	na	--
Cyanide, Free	0	2.2E+01	5.2E+00	na	1.6E+04	6.2E+01	1.5E+01	na	4.5E+04	--	--	--	--	--	--	--	--	6.2E+01	1.5E+01	na	4.5E+04
DDD [C]	0	--	--	na	3.1E-03	--	--	na	8.7E-03	--	--	--	--	--	--	--	--	--	--	na	8.7E-03
DDE [C]	0	--	--	na	2.2E-03	--	--	na	6.2E-03	--	--	--	--	--	--	--	--	--	--	na	6.2E-03
DDT [C]	0	1.1E+00	1.0E-03	na	2.2E-03	3.1E+00	2.8E-03	na	6.2E-03	--	--	--	--	--	--	--	--	3.1E+00	2.8E-03	na	6.2E-03
Demeton	0	--	1.0E-01	na	--	--	2.8E-01	na	--	--	--	--	--	--	--	--	--	--	2.8E-01	na	--
Diazinon	0	1.7E-01	1.7E-01	na	--	4.8E-01	4.8E-01	na	--	--	--	--	--	--	--	--	--	4.8E-01	4.8E-01	na	--
Dibenz(a,h)anthracene [C]	0	--	--	na	1.8E-01	--	--	na	5.1E-01	--	--	--	--	--	--	--	--	--	--	na	5.1E-01
1,2-Dichlorobenzene	0	--	--	na	1.3E+03	--	--	na	3.6E+03	--	--	--	--	--	--	--	--	--	--	na	3.6E+03
1,3-Dichlorobenzene	0	--	--	na	9.6E+02	--	--	na	2.7E+03	--	--	--	--	--	--	--	--	--	--	na	2.7E+03
1,4-Dichlorobenzene	0	--	--	na	1.9E+02	--	--	na	5.3E+02	--	--	--	--	--	--	--	--	--	--	na	5.3E+02
3,3-Dichlorobenzidine[C]	0	--	--	na	2.8E-01	--	--	na	7.9E-01	--	--	--	--	--	--	--	--	--	--	na	7.9E-01
Dichlorobromomethane [C]	0	--	--	na	1.7E+02	--	--	na	4.8E+02	--	--	--	--	--	--	--	--	--	--	na	4.8E+02
1,2-Dichloroethane [C]	0	--	--	na	3.7E+02	--	--	na	1.0E+03	--	--	--	--	--	--	--	--	--	--	na	1.0E+03
1,1-Dichloroethylene	0	--	--	na	7.1E+03	--	--	na	2.0E+04	--	--	--	--	--	--	--	--	--	--	na	2.0E+04
1,2-trans-dichloroethylene	0	--	--	na	1.0E+04	--	--	na	2.8E+04	--	--	--	--	--	--	--	--	--	--	na	2.8E+04
2,4-Dichlorophenol	0	--	--	na	2.9E+02	--	--	na	8.1E+02	--	--	--	--	--	--	--	--	--	--	na	8.1E+02
2,4-Dichlorophenoxy acetic acid (2,4-D)	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	--	--	na	--
1,2-Dichloropropane[C]	0	--	--	na	1.5E+02	--	--	na	4.2E+02	--	--	--	--	--	--	--	--	--	--	na	4.2E+02
1,3-Dichloropropene [C]	0	--	--	na	2.1E+02	--	--	na	5.9E+02	--	--	--	--	--	--	--	--	--	--	na	5.9E+02
Dieldrin [C]	0	2.4E-01	5.6E-02	na	5.4E-04	6.7E-01	1.6E-01	na	1.5E-03	--	--	--	--	--	--	--	--	6.7E-01	1.6E-01	na	1.5E-03
Diethyl Phthalate	0	--	--	na	4.4E+04	--	--	na	1.2E+05	--	--	--	--	--	--	--	--	--	--	na	1.2E+05
2,4-Dimethylphenol	0	--	--	na	8.5E+02	--	--	na	2.4E+03	--	--	--	--	--	--	--	--	--	--	na	2.4E+03
Dimethyl Phthalate	0	--	--	na	1.1E+06	--	--	na	3.1E+06	--	--	--	--	--	--	--	--	--	--	na	3.1E+06
Di-n-Butyl Phthalate	0	--	--	na	4.5E+03	--	--	na	1.3E+04	--	--	--	--	--	--	--	--	--	--	na	1.3E+04
2,4 Dinitrophenol	0	--	--	na	5.3E+03	--	--	na	1.5E+04	--	--	--	--	--	--	--	--	--	--	na	1.5E+04
2-Methyl-4,6-Dinitrophenol	0	--	--	na	2.8E+02	--	--	na	7.9E+02	--	--	--	--	--	--	--	--	--	--	na	7.9E+02
2,4-Dinitrotoluene [C]	0	--	--	na	3.4E+01	--	--	na	9.5E+01	--	--	--	--	--	--	--	--	--	--	na	9.5E+01
Dioxin 2,3,7,8-tetrachlorodibenzo-p-dioxin	0	--	--	na	5.1E-08	--	--	na	1.4E-07	--	--	--	--	--	--	--	--	--	--	na	1.4E-07
1,2-Diphenylhydrazine[C]	0	--	--	na	2.0E+00	--	--	na	5.6E+00	--	--	--	--	--	--	--	--	--	--	na	5.6E+00
Alpha-Endosulfan	0	2.2E-01	5.6E-02	na	8.9E+01	6.2E-01	1.6E-01	na	2.5E+02	--	--	--	--	--	--	--	--	6.2E-01	1.6E-01	na	2.5E+02
Beta-Endosulfan	0	2.2E-01	5.6E-02	na	8.9E+01	6.2E-01	1.6E-01	na	2.5E+02	--	--	--	--	--	--	--	--	6.2E-01	1.6E-01	na	2.5E+02
Alpha + Beta Endosulfan	0	2.2E-01	5.6E-02	--	--	6.2E-01	1.6E-01	--	--	--	--	--	--	--	--	--	--	6.2E-01	1.6E-01	--	--
Endosulfan Sulfate	0	--	--	na	8.9E+01	--	--	na	2.5E+02	--	--	--	--	--	--	--	--	--	--	na	2.5E+02
Endrin	0	8.6E-02	3.6E-02	na	6.0E-02	2.4E-01	1.0E-01	na	1.7E-01	--	--	--	--	--	--	--	--	2.4E-01	1.0E-01	na	1.7E-01
Endrin Aldehyde	0	--	--	na	3.0E-01	--	--	na	8.4E-01	--	--	--	--	--	--	--	--	--	--	na	8.4E-01

Parameter	Background	Water Quality Criteria				Wasteload Allocations				Antidegradation Baseline				Antidegradation Allocations				**Most Limiting Allocations**			
(ug/l unless noted)	Conc.	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	**Acute**	**Chronic**	**HH (PWS)**	**HH**
Ethylbenzene	0	--	--	na	2.1E+03	--	--	na	5.9E+03	--	--	--	--	--	--	--	--	--	--	na	5.9E+03
Fluoranthene	0	--	--	na	1.4E+02	--	--	na	3.9E+02	--	--	--	--	--	--	--	--	--	--	na	3.9E+02
Fluorene	0	--	--	na	5.3E+03	--	--	na	1.5E+04	--	--	--	--	--	--	--	--	--	--	na	1.5E+04
Foaming Agents	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	--	--	na	--
Guthion	0	--	1.0E-02	na	--	--	2.8E-02	na	--	--	--	--	--	--	--	--	--	--	2.8E-02	na	--
Heptachlor [C]	0	5.2E-01	3.8E-03	na	7.9E-04	1.5E+00	1.1E-02	na	2.2E-03	--	--	--	--	--	--	--	--	1.5E+00	1.1E-02	na	2.2E-03
Heptachlor Epoxide[C]	0	5.2E-01	3.8E-03	na	3.9E-04	1.5E+00	1.1E-02	na	1.1E-03	--	--	--	--	--	--	--	--	1.5E+00	1.1E-02	na	1.1E-03
Hexachlorobenzene[C]	0	--	--	na	2.9E-03	--	--	na	8.1E-03	--	--	--	--	--	--	--	--	--	--	na	8.1E-03
Hexachlorobutadiene[C]	0	--	--	na	1.8E+02	--	--	na	5.1E+02	--	--	--	--	--	--	--	--	--	--	na	5.1E+02
Hexachlorocyclohexane Alpha-BHC[C]	0	--	--	na	4.9E-02	--	--	na	1.4E-01	--	--	--	--	--	--	--	--	--	--	na	1.4E-01
Hexachlorocyclohexane Beta-BHC[C]	0	--	--	na	1.7E-01	--	--	na	4.8E-01	--	--	--	--	--	--	--	--	--	--	na	4.8E-01
Hexachlorocyclohexane Gamma-BHC[C] (Lindane)	0	9.5E-01	na	na	1.8E+00	2.7E+00	--	na	5.1E+00	--	--	--	--	--	--	--	--	2.7E+00	--	na	5.1E+00
Hexachlorocyclopentadiene	0	--	--	na	1.1E+03	--	--	na	3.1E+03	--	--	--	--	--	--	--	--	--	--	na	3.1E+03
Hexachloroethane[C]	0	--	--	na	3.3E+01	--	--	na	9.3E+01	--	--	--	--	--	--	--	--	--	--	na	9.3E+01
Hydrogen Sulfide	0	--	2.0E+00	na	--	--	5.6E+00	na	--	--	--	--	--	--	--	--	--	--	5.6E+00	na	--
Indeno (1,2,3-cd) pyrene [C]	0	--	--	na	1.8E-01	--	--	na	5.1E-01	--	--	--	--	--	--	--	--	--	--	na	5.1E-01
Iron	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	--	--	na	--
Isophorone[C]	0	--	--	na	9.6E+03	--	--	na	2.7E+04	--	--	--	--	--	--	--	--	--	--	na	2.7E+04
Kepone	0	--	0.0E+00	na	--	--	0.0E+00	na	--	--	--	--	--	--	--	--	--	--	0.0E+00	na	--
Lead	0	5.7E+02	6.5E+01	na	--	1.6E+03	1.8E+02	na	--	--	--	--	--	--	--	--	--	1.6E+03	1.8E+02	na	--
Malathion	0	--	1.0E-01	na	--	--	2.8E-01	na	--	--	--	--	--	--	--	--	--	--	2.8E-01	na	--
Manganese	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	--	--	na	--
Mercury	0	1.4E+00	7.7E-01	- -	- -	3.9E+00	2.2E+00	- -	- -	--	--	--	--	--	--	--	--	3.9E+00	2.2E+00	- -	- -
Methyl Bromide	0	--	--	na	1.5E+03	--	--	na	4.2E+03	--	--	--	--	--	--	--	--	--	--	na	4.2E+03
Methylene Chloride [C]	0	--	--	na	5.9E+03	--	--	na	1.7E+04	--	--	--	--	--	--	--	--	--	--	na	1.7E+04
Methoxychlor	0	--	3.0E-02	na	--	--	8.4E-02	na	--	--	--	--	--	--	--	--	--	--	8.4E-02	na	--
Mirex	0	--	0.0E+00	na	--	--	0.0E+00	na	--	--	--	--	--	--	--	--	--	--	0.0E+00	na	--
Nickel	0	5.2E+02	5.7E+01	na	4.6E+03	1.4E+03	1.6E+02	na	1.3E+04	--	--	--	--	--	--	--	--	1.4E+03	1.6E+02	na	1.3E+04
Nitrate (as N)	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	--	--	na	--
Nitrobenzene	0	--	--	na	6.9E+02	--	--	na	1.9E+03	--	--	--	--	--	--	--	--	--	--	na	1.9E+03
N-Nitrosodimethylamine[C]	0	--	--	na	3.0E+01	--	--	na	8.4E+01	--	--	--	--	--	--	--	--	--	--	na	8.4E+01
N-Nitrosodiphenylamine[C]	0	--	--	na	6.0E+01	--	--	na	1.7E+02	--	--	--	--	--	--	--	--	--	--	na	1.7E+02
N-Nitrosodi-n-propylamine[C]	0	--	--	na	5.1E+00	--	--	na	1.4E+01	--	--	--	--	--	--	--	--	--	--	na	1.4E+01
Nonylphenol	0	2.8E+01	6.6E+00	--	--	7.9E+01	1.9E+01	na	--	--	--	--	--	--	--	--	--	7.9E+01	1.9E+01	na	--
Parathion	0	6.5E-02	1.3E-02	na	--	1.8E-01	3.6E-02	na	--	--	--	--	--	--	--	--	--	1.8E-01	3.6E-02	na	--
PCB Total[C]	0	--	1.4E-02	na	6.4E-04	--	3.9E-02	na	1.8E-03	--	--	--	--	--	--	--	--	--	3.9E-02	na	1.8E-03
Pentachlorophenol [C]	0	2.3E+01	1.8E+01	na	3.0E+01	6.5E+01	5.0E+01	na	8.4E+01	--	--	--	--	--	--	--	--	6.5E+01	5.0E+01	na	8.4E+01
Phenol	0	--	--	na	8.6E+05	--	--	na	2.4E+06	--	--	--	--	--	--	--	--	--	--	na	2.4E+06
Pyrene	0	--	--	na	4.0E+03	--	--	na	1.1E+04	--	--	--	--	--	--	--	--	--	--	na	1.1E+04
Radionuclides	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	--	--	na	--
Gross Alpha Activity (pCi/L)	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	--	--	na	--
Beta and Photon Activity (mrem/yr)	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	--	--	na	--
Radium 226 + 228 (pCi/L)	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	--	--	na	--
Uranium (ug/l)	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	--	--	na	--

Parameter	Background	Water Quality Criteria				Wasteload Allocations				Antidegradation Baseline				Antidegradation Allocations				**Most Limiting Allocations**			
(ug/l unless noted)	Conc.	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	Acute	Chronic	HH (PWS)	HH	**Acute**	**Chronic**	**HH (PWS)**	**HH**
Selenium, Total Recoverable	0	2.0E+01	5.0E+00	na	4.2E+03	5.6E+01	1.4E+01	na	1.2E+04	--	--	--	--	--	--	--	--	**5.6E+01**	**1.4E+01**	**na**	**1.2E+04**
Silver	0	2.9E+01	--	na	--	8.0E+01	--	na	--	--	--	--	--	--	--	--	--	**8.0E+01**	**--**	**na**	**--**
Sulfate	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**--**
1,1,2,2-Tetrachloroethane[C]	0	--	--	na	4.0E+01	--	--	na	1.1E+02	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**1.1E+02**
Tetrachloroethylene[C]	0	--	--	na	3.3E+01	--	--	na	9.3E+01	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**9.3E+01**
Thallium	0	--	--	na	4.7E-01	--	--	na	1.3E+00	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**1.3E+00**
Toluene	0	--	--	na	6.0E+03	--	--	na	1.7E+04	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**1.7E+04**
Total dissolved solids	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**--**
Toxaphene [C]	0	7.3E-01	2.0E-04	na	2.8E-03	2.0E+00	5.6E-04	na	7.9E-03	--	--	--	--	--	--	--	--	**2.0E+00**	**5.6E-04**	**na**	**7.9E-03**
Tributyltin	0	4.6E-01	7.2E-02	na	--	1.3E+00	2.0E-01	na	--	--	--	--	--	--	--	--	--	**1.3E+00**	**2.0E-01**	**na**	**--**
1,2,4-Trichlorobenzene	0	--	--	na	7.0E+01	--	--	na	2.0E+02	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**2.0E+02**
1,1,2-Trichloroethane[C]	0	--	--	na	1.6E+02	--	--	na	4.5E+02	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**4.5E+02**
Trichloroethylene [C]	0	--	--	na	3.0E+02	--	--	na	8.4E+02	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**8.4E+02**
2,4,6-Trichlorophenol [C]	0	--	--	na	2.4E+01	--	--	na	6.7E+01	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**6.7E+01**
2-(2,4,5-Trichlorophenoxy) propionic acid (Silvex)	0	--	--	na	--	--	--	na	--	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**--**
Vinyl Chloride[C]	0	--	--	na	2.4E+01	--	--	na	6.7E+01	--	--	--	--	--	--	--	--	**--**	**--**	**na**	**6.7E+01**
Zinc	0	3.3E+02	3.3E+02	na	2.6E+04	9.3E+02	9.4E+02	na	7.3E+04	--	--	--	--	--	--	--	--	**9.3E+02**	**9.4E+02**	**na**	**7.3E+04**

Notes:

1. All concentrations expressed as micrograms/liter (ug/l), unless noted otherwise
2. Discharge flow is highest monthly average or Form 2C maximum for Industries and design flow for Municipals
3. Metals measured as Dissolved, unless specified otherwise
4. "C" indicates a carcinogenic parameter
5. Regular WLAs are mass balances (minus background concentration) using the % of stream flow entered above under Mixing Information.
   Antidegradation WLAs are based upon a complete mix.
6. Antideg. Baseline = (0.25(WQC - background conc.) + background conc.) for acute and chronic
   = (0.1(WQC - background conc.) + background conc.) for human health
7. WLAs established at the following stream flows: 1Q10 for Acute, 30Q10 for Chronic Ammonia, 7Q10 for Other Chronic, 30Q5 for Non-carcinogens and
   Harmonic Mean for Carcinogens. To apply mixing ratios from a model set the stream flow equal to (mixing ratio - 1), effluent flow equal to 1 and 100% mix.

Metal	Target Value (SSTV)
Antimony	1.8E+03
Arsenic	2.5E+02
Barium	na
Cadmium	5.0E+00
Chromium III	3.4E+02
Chromium VI	1.8E+01
Copper	4.3E+01
Iron	na
Lead	1.1E+02
Manganese	na
Mercury	1.3E+00
Nickel	9.7E+01
Selenium	8.4E+00
Silver	3.2E+01
Zinc	3.7E+02

Note: do not use QL's lower than the minimum QL's provided in agency guidance

<u>Chemical = Ammonia</u>
Chronic averaging period = 30
WLAa = 25 WLAc = 3.68 Q.L. = 0.2 # samples/mo. = 1 # samples/wk. = 1

<u>Summary of Statistics:</u>
observations = 52 Expected Value = 0.275386 Variance = 0.771858 C.V. = 3.190262
97th percentile daily values = 1.62332
97th percentile 4 day average = 0.664476
97th percentile 30 day average= 0.434905
< Q.L. = 42 Model used = delta lognormal
The data are: 0.48, 0.74, 0.75, 0.22, 0.13, 0.21, 0.58, 0.17, 8.9, 0.57, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 & 0 (a year of weekly values)

No Limit is required for this material

<u>Chemical = Arsenic</u>
Chronic averaging period = 4
WLAa = 950 WLAc = 420 Q.L. = 5 # samples/mo. = 1 # samples/wk. = 1

<u>Summary of Statistics</u>:
observations = 3 Expected Value = 4.63874 Variance = 7.74646 C.V. = 0.6
97th percentile daily values = 11.2880
97th percentile 4 day average = 7.71789
97th percentile 30 day average = 5.59457
< Q.L. = 2 Model used = BPJ Assumptions, Type 1 data
The data are: 6, 0 & 0

No Limit is required for this material

<u>Chemical = Chromium III</u>
Chronic averaging period = 4
WLAa = 4400 WLAc = 570 Q.L. = 1 # samples/mo. = 1 # samples/wk. = 1

<u>Summary of Statistics:</u>
observations = 1 Expected Value = 3 Variance = 3.24 C.V. = 0.6
97th percentile daily values = 7.30025
97th percentile 4 day average = 4.99137
97th percentile 30 day average = 3.61815
< Q.L. = 0 Model used = BPJ Assumptions, type 2 data
The data are: 3

No Limit is required for this material

Chemical = Copper

Chronic averaging period = 4
WLAa = 120 WLAc = 72 Q.L. = 4 # samples/mo. = 1 # samples/wk. = 1

Summary of Statistics:
observations = 3 Expected Value = 3.71099 Variance = 4.95773 C.V. = 0.6
97th percentile daily values = 9.03040
97th percentile 4 day average = 6.17431
97th percentile 30 day average = 4.47565
< Q.L. = 2 Model used = BPJ Assumptions, Type 1 data
The data are: 4, 0 & 0

No Limit is required for this material

Chemical = Lead

Chronic averaging period = 4
WLAa = 1600 WLAc = 180 Q.L. = 0.2 # samples/mo. = 1 # samples/wk. = 1

Summary of Statistics:
observations = 3 Expected Value = 0.185549 Variance = 0.012394 C.V. = 0.6
97th percentile daily values = 0.451520
97th percentile 4 day average = 0.308715
97th percentile 30 day average= 0.223782
< Q.L. = 2 Model used = BPJ Assumptions, Type 1 data
The data are: 0, 0.89 & 0

No Limit is required for this material

Chemical = Selenium

Chronic averaging period = 4
WLAa = 56 WLAc = 14 Q.L. = 2 # samples/mo. = 1 # samples/wk. = 1

Summary of Statistics:
observations = 3 Expected Value = 2.97671 Variance = 3.18989 C.V. = 0.6
97th percentile daily values = 7.24358
97th percentile 4 day average = 4.95262
97th percentile 30 day average = 3.59007
< Q.L. = 1 Model used = BPJ Assumptions, Type 1 data
The data are: 3, 4.75 & 0

No Limit is required for this material

Thermal Variance Continuance Request

The purpose of this section is to formally request the continuation of the existing thermal variance as it concerns MeadWestvaco's Covington, VA operations.

The Executive Secretary of the State Water Control Board approved the 316(a) demonstration for MeadWestvaco's operations in Covington, VA on February 7, 1980. Since that time conditions responsible for the initial variance request have not changed. River flows and river temperatures have not changed in any significant manner. Thermal discharges were reduced significantly in the past due to the implementation of the Heat Load Reduction Project. However, discharges still result in the continuing need for the thermal variance.

In addition to the original 316(a) Demonstration Report submitted to the SWCB on September 5, 1979, MeadWestvaco has supplied the Department of Environmental Quality (DEQ) with additional information supporting the decision to grant the thermal variance. A November 1990 report prepared by Energy & Environmental Management Inc. (EEM) entitled "Thermohydraulic Model Verification and Temperature Effects Study at MeadWestvaco's Covington Mill" concluded "that the thermohydraulic model is verified for application to the Jackson River between Gathright Dam and Clifton Forge". It also concluded "that continued discharge of waste heat at current levels from the Covington mill will not cause an imbalance of the indigenous RIS".

In a February 8, 1994 letter to the DEQ, MeadWestvaco provided additional information concerning the verification of the thermohydraulic model. Graphs of the predicted versus the measured downstream river temperatures were provided. These graphs indicated the model accurately predicted downstream river temperatures.

On October 30, 1998 MeadWestvaco provided DEQ with two reports prepared by EA Engineering, Science, and Technology (EA). These two reports were entitled "Evaluation of Jackson River Temperature Model" and "Summary of Fisheries Information for the Jackson and James Rivers". Both of these reports support the continuation of the present thermal variance. The latter report concludes "The available information does support the overall conclusion that the Covington Mill discharges do not appear to be precluding maintenance of a balanced indigenous fish community in the Jackson River and adjacent areas of the James River".

It is not expected that the conclusions drawn from the studies indicated above would be any different under the current mill operations or those expected in the future.

EVALUATION OF JACKSON RIVER TEMPERATURE MODEL

Prepared for

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Covington, Virginia

Prepared by

EA Engineering, Science, and Technology
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October 1998
11313.10

1. INTRODUCTION

A longitudinal thermohydraulic model was developed for the Jackson River as part of previous Section 316(a) studies. The model simulates temperature in the Jackson River from Gathright Dam downstream to past the Covington Mill. Inputs to the model include the flow and temperature of water released from Gathright Dam, meteorological data from Roanoke Airport, USGS river flow data, and the heat loading from the Covington Mill. The model includes 40 river cells extending from Gathright Dam, 17.8 miles upstream of the Covington Mill, to a location 19.1 miles downstream of the mill. Westvaco has developed a data base of Jackson River temperatures for the years 1990 to present. The stations included in the river sampling are provided in Table 1. The objective of the analysis provided in this document was to examine model validation by comparing predicted model temperatures to observed river temperatures.

The model input file includes daily flow data at the USGS stations at Jackson River below Gathright Dam, Jackson River below Dunlap Creek, Dunlap Creek, and Potts Creek. The daily heat loading for the summation of outfalls 001, 002, and 003 is also provided to the model. For this report, the model was started at model cell 19, 1.2 miles upstream of Outfall 003, using the daily Covington Mill intake temperature data. Outfall 003 is in model cell 20. The model validation was performed only for the Jackson River downstream of the Covington Mill. For this report, the Jackson River flow data at the location downstream of Dunlap Creek had been obtained for the January 1990 to September 1996. The comparison of observed and predicted Jackson River temperature presented in the following sections was performed for the nearly 7 year, 1990 to September 1996, period.

2. MODEL SENSITIVITY TO METEOROLOGICAL DATA

Modeled surface heat exchange between the atmosphere and the river surface is based on an equilibrium temperature and a surface heat exchange coefficient which are calculated from daily meteorological data. These two surface heat exchange parameters were available from an existing model input file for the October 1983 to September 1989 period. The initial model evaluation contained in this document used this historical heat exchange data. Successive model runs were executed for the 1990-1994 period using in turn the daily 1984, 1985, 1986, 1987 and 1988 surface heat exchange parameters. The purpose of this analysis was to examine the model sensitivity to meteorological data and to select a "typical" year of meteorological data for use in the comparison of predicted and observed river temperatures.

The model sensitivity results for meteorological conditions are summarized in Table 2. Table 2 provides the predicted annual average Jackson River temperature at model cell 22 (1.3 miles downstream) and model cell 35 (14 miles downstream). Model cell 35 is 2.5 miles downstream of the furthest river sampling station. Because model cell 22 is nearer to the upstream model boundary, surface heat exchange has had only a short time to effect downstream temperatures. As a result, the difference in annual average temperature is no more than 0.2 degrees F between the five meteorological data scenarios (1984 to 1988). The temperature difference between years (1990-1994) is dependent on the initial model temperature, river flow data, and mill heat loading. The coolest year was 1992 (59.7 -59.8 F) while the warmest year was 1994 (61.1-61.3 F). At model cell 35, surface heat exchange has had a longer time to act, resulting in a greater difference between the meteorological data scenarios. For any given year (1990-1994), the highest temperatures resulted from using the 1986 meteorological data and the lowest temperatures from the 1985 or 1988 data. The 1984 meteorological data scenario provided a mid-range result. The 1984 meteorological data was used to represent "typical" conditions in the comparison between predicted and observed river temperature in the following section. The variability in meteorological data from year-to-year is not enough to significantly impact the distribution of predicted river temperatures when summarized on a monthly or seasonal basis.

3. COMPARISON BETWEEN PREDICTED AND OBSERVED TEMPERATURE

A comparison between predicted and observed Jackson River temperatures is provided in Table 3 at 10 river sampling locations. The table provides a frequency distribution, mean, and standard deviation of the difference between predicted and observed temperatures for the 1990-1996 period. At the filtration plant (RM -0.6), the mean predicted temperature is 2.4 degrees F higher than observed values. At this model location, the predicted temperature is highly dependent on the plant intake temperature used at the model boundary. The 2 degrees F temperature difference between the plant intake data set and the values at the filtration plant are persistent in the model through the first mile downstream. Downstream of RM 1.3 (Swinging Bridge), the mean temperature difference decreases and is less then 0.5 degrees F between RM 5.5 and RM 11.5. The 50 percentile temperatures are typically several tenths of a degree higher than the mean temperatures. The standard deviation of the difference between predicted and observed temperature is typically 4 degrees F.

A frequency distribution by season is provided in Tables 4 to 10 for the river temperature stations RM 0.1, RM 1.7, RM 3.3, RM 5.5, RM 7.4, RM 9.5, and RM 11.5. The mean difference in predicted minus observed temperatures between seasons with more than 20 observations was typically within 1.0 degrees F. The standard deviation during the summer was less than the other seasons for all seven of the stations presented.

4. CONCLUSIONS

In general, the model provides a good fit to the observed data as represented by the mean difference between the predicted and observed temperatures. The variability between predicted and observed temperature, standard deviation typically 4 degrees F, is larger than one might expect. However, the seasonal frequency distributions indicate that the best model fit was obtained during the summer with a standard deviation that varied between 2.7 and 3.3 degrees F at stations downstream of Mill Bridge.. The positive bias of the model, mean predicted temperature higher than observed, and a portion of the model variability is attributable to the fact that the river sampling is frequently performed in the early morning in order to monitor the minimum dissolved oxygen. The difference between early morning and daily average temperature could easily differ by several degrees F due to diurnal solar heating. The over prediction of the model decreases in the downstream direction.

TABLE 1 SAMPLING LOCATIONS FOR THE COLLECTION OF JACKSON RIVER TEMPERATURE DATA

Station	Distance form Mill (mi)	Model Cell
Filtration Plant	-0.6	19
Mill Dam East	0.0	19
Mill Dam West	0.0	19
Mill Bridge	0.1	20
Playground	0.9	22
Swinging Bridge	1.3	22
Fudges Bridge	1.7	23
Hercules Bridge	3.3	25
Ildewilde Bridge	5.5	27
Mallow Mall Bridge	7.4	29
Island Ford Bridge	9.5	31
Valley Ridge Bridge	11.5	33
Dunlap Creek	---	---
Potts Creek	---	---

TABLE 2 ANNUAL AVERAGE MODEL PREDICTED JACKSON RIVER TEMPERATURE FOR FIVE SURFACE HEAT EXCHANGE SCENARIOS

Model Cell 22 - 1.3 miles Downstream from Covington Mill

Meteorological Data	Annual Average Model Predicted Temperature (F)				
	1990	1991	1992	1993	1994
1984	60.4	60.8	59.7	60.6	61.2
1985	60.4	60.8	59.7	60.5	61.1
1986	60.4	60.9	59.8	60.6	61.3
1987	60.4	60.9	59.8	60.6	61.3
1988	60.2	60.7	59.7	60.5	61.1

Model Cell 35 - 14 miles Downstream from Covington Mill

Meteorological Data	Annual Average Model Predicted Temperature (F)				
	1990	1991	1992	1993	1994
1984	58.7	58.9	57.8	58.4	58.6
1985	58.4	58.6	57.5	57.9	58.3
1986	58.9	59.2	58.1	58.6	58.9
1987	58.8	59.1	58.0	58.5	58.8
1988	58.4	58.6	57.6	58.0	58.3

TABLE 3 FREQUENCY ANALYSIS OF THE TEMPERATURE DIFFERENCE BETWEEN PREDICTED AND OBSERVED JACKSON RIVER TEMPERATURES (1990-1996)

Percentile	Predicted - Observed Temperature (F) at River Station									
(%)	RM -0.6	RM 0.1	RM 0.9	RM 1.3	RM 1.7	RM 3.3	RM 5.5	RM 7.4	RM 9.5	RM 11.5
10.0	-0.7	-0.7	-1.4	-2.1	-2.1	-3.0	-4.2	-4.8	-5.6	-5.1
15.0	0.2	0.2	-0.7	-1.4	-1.6	-2.2	-3.3	-3.2	-3.9	-3.7
20.0	0.6	0.7	0.1	-0.9	-1.2	-1.6	-2.5	-2.5	-2.6	-2.9
25.0	1.2	1.2	0.6	-0.4	-0.6	-1.0	-2.0	-1.9	-2.2	-2.3
30.0	1.5	1.6	0.9	0.0	0.0	-0.7	-1.5	-1.6	-1.9	-1.8
35.0	1.8	1.8	1.2	0.4	0.4	-0.3	-1.1	-1.2	-1.0	-0.8
40.0	2.0	2.2	1.5	0.8	0.9	0.2	-0.6	-0.2	-0.7	-0.3
45.0	2.3	2.4	1.8	1.4	1.3	0.8	0.1	0.2	0.2	0.4
50.0	2.6	2.7	2.5	1.7	1.6	1.2	0.6	0.9	0.8	0.8
55.0	2.9	2.9	2.8	1.9	2.0	1.6	1.1	1.4	1.6	1.5
60.0	3.2	3.3	3.2	2.4	2.4	1.9	1.4	1.7	1.9	1.9
65.0	3.4	3.6	3.5	2.8	2.8	2.4	1.8	2.0	2.1	2.3
70.0	3.8	4.1	4.0	3.4	3.2	2.7	2.2	2.5	2.4	2.8
75.0	4.1	4.6	4.4	3.7	3.6	3.3	2.8	2.9	3.0	3.3
80.0	4.3	5.0	4.8	4.2	4.2	3.6	3.4	3.6	3.5	3.7
85.0	4.8	5.6	5.5	4.6	4.8	4.4	4.1	4.4	4.8	4.7
90.0	5.3	5.8	6.0	5.1	5.3	5.1	4.8	5.0	5.2	5.9
MEAN	2.4	2.7	2.3	1.6	1.5	1.0	0.3	0.4	0.2	0.5
SD DEV	4.2	4.8	4.5	4.1	3.9	3.7	3.7	4.0	4.1	4.5
OBS	253.0	258.0	135.0	225.0	258.0	258.0	255.0	130.0	129.0	247.0

TABLE 4 SEASONAL FREQUENCY ANALYSIS OF PREDICTED MINUS OBSERVED JACKSON RIVER TEMPERATURES AT MILL BRIDGE (RM 0.1)

Percentile	Predicted - Observed Temperature (F)				
(%)	Winter	Spring	Summer	Fall	Year
10.0	-1.7	0.2	-0.3	-1.1	-0.7
15.0	-0.8	0.6	0.7	-0.5	0.2
20.0	0.6	0.9	1.1	0.2	0.7
25.0	1.1	1.5	1.6	0.5	1.2
30.0	1.4	2.0	1.7	1.0	1.6
35.0	1.9	2.2	2.1	1.4	1.8
40.0	2.9	2.4	2.2	1.6	2.2
45.0	3.2	2.7	2.5	2.0	2.4
50.0	3.3	3.0	2.7	2.4	2.7
55.0	3.3	3.5	2.9	2.7	2.9
60.0	4.2	3.8	3.3	2.8	3.3
65.0	4.3	4.2	3.6	3.4	3.6
70.0	4.6	5.5	4.1	3.7	4.1
75.0	4.8	5.6	4.4	4.0	4.6
80.0	5.2	6.0	4.6	5.0	5.0
85.0	5.4	6.3	5.2	5.7	5.6
90.0	5.6	6.7	5.5	6.3	5.8
MEAN	2.9	3.1	2.7	2.5	2.7
SD DEV	5.1	5.4	4.4	4.8	4.8
OBS	18.0	46.0	104.0	90.0	258.0

TABLE 5 SEASONAL FREQUENCY ANALYSIS OF PREDICTED MINUS OBSERVED JACKSON RIVER TEMPERATURES AT FUDGES BRIDGE (RM 1.7)

Percentile	Predicted - Observed Temperature (F)				
(%)	Winter	Spring	Summer	Fall	Year
10.0	-2.2	-5.0	-2.1	-1.9	-2.1
15.0	-1.8	-2.8	-1.6	-1.2	-1.6
20.0	-1.6	-2.0	-1.3	-1.0	-1.2
25.0	0.3	-0.6	-0.8	-0.3	-0.6
30.0	0.3	-0.1	-0.4	0.0	0.0
35.0	1.0	0.4	0.3	0.7	0.4
40.0	1.2	0.9	0.6	1.3	0.9
45.0	2.8	1.0	0.9	1.4	1.3
50.0	3.1	1.4	1.5	1.9	1.6
55.0	3.1	1.6	1.9	2.6	2.0
60.0	3.6	2.0	2.2	2.8	2.4
65.0	4.1	2.3	2.5	3.0	2.8
70.0	4.2	3.6	2.8	3.7	3.2
75.0	4.5	4.2	3.2	4.3	3.6
80.0	5.3	4.6	3.5	5.1	4.2
85.0	5.8	4.8	3.6	5.5	4.8
90.0	7.2	5.1	4.3	6.5	5.3
MEAN	2.5	1.0	1.2	2.1	1.5
SD DEV	5.1	4.1	3.1	4.5	3.9
OBS	18.0	46.0	104.0	90.0	258.0

TABLE 6 SEASONAL FREQUENCY ANALYSIS OF PREDICTED MINUS OBSERVED JACKSON RIVER TEMPERATURES AT HERCULES BRIDGE (RM 3.3)

Percentile	Predicted - Observed Temperature (F)				
(%)	Winter	Spring	Summer	Fall	Year
10.0	-1.0	-6.0	-3.2	-2.9	-3.0
15.0	-1.0	-2.8	-2.4	-2.2	-2.2
20.0	-0.9	-1.6	-1.9	-1.7	-1.6
25.0	-0.3	-0.9	-1.3	-1.0	-1.0
30.0	0.1	-0.6	-0.9	-0.7	-0.7
35.0	0.7	-0.6	-0.7	0.1	-0.3
40.0	1.7	-0.1	-0.3	0.5	0.2
45.0	2.9	0.4	0.8	0.9	0.8
50.0	3.5	1.0	1.2	1.2	1.2
55.0	3.5	1.3	1.5	1.6	1.6
60.0	3.6	1.6	1.9	1.8	1.9
65.0	4.4	2.3	2.0	2.7	2.4
70.0	4.8	2.6	2.5	3.0	2.7
75.0	4.9	3.7	2.7	3.6	3.3
80.0	4.9	4.3	3.2	4.5	3.6
85.0	6.7	4.4	3.4	5.5	4.4
90.0	8.1	4.8	3.6	5.8	5.1
MEAN	2.7	0.4	0.7	1.3	1.0
SD DEV	5.3	4.2	2.9	4.0	3.7
OBS	18.0	46.0	104.0	90.0	258.0

TABLE 7 SEASONAL FREQUENCY ANALYSIS OF PREDICTED MINUS OBSERVED JACKSON RIVER TEMPERATURES AT ILDEWILDE BRIDGE (RM 5.5)

Percentile	Predicted - Observed Temperature (F)				
(%)	Winter	Spring	Summer	Fall	Year
10.0	-1.6	-6.6	-4.1	-4.7	-4.2
15.0	-1.2	-3.2	-3.3	-3.7	-3.3
20.0	0.7	-2.2	-2.4	-2.8	-2.5
25.0	0.8	-1.7	-2.0	-2.5	-2.0
30.0	1.1	-1.1	-1.7	-2.1	-1.5
35.0	1.4	0.0	-1.3	-1.5	-1.1
40.0	1.4	0.3	-0.4	-1.2	-0.6
45.0	2.7	0.6	-0.1	-0.7	0.1
50.0	3.6	1.4	0.4	-0.3	0.6
55.0	3.6	1.9	0.5	0.9	1.1
60.0	3.7	2.1	0.9	1.3	1.4
65.0	4.3	3.3	1.3	1.5	1.8
70.0	5.7	3.5	1.8	2.3	2.2
75.0	6.9	3.9	2.1	2.8	2.8
80.0	7.4	4.4	2.3	3.6	3.4
85.0	8.1	4.6	2.8	4.3	4.1
90.0	8.1	5.6	3.1	5.9	4.8
MEAN	3.1	0.5	0.0	0.1	0.3
SD DEV	6.1	4.5	2.7	4.0	3.7
OBS	18.0	44.0	103.0	90.0	255.0

TABLE 8 SEASONAL FREQUENCY ANALYSIS OF PREDICTED MINUS OBSERVED JACKSON RIVER TEMPERATURES AT MALLOW MALL BRIDGE (RM 7.4)

Percentile	Predicted - Observed Temperature (F)				
(%)	Winter	Spring	Summer	Fall	Year
10.0	-7.5	-3.1	-4.1	-5.9	-4.8
15.0	-7.5	-2.3	-3.4	-4.8	-3.2
20.0	-7.5	-1.5	-2.5	-3.0	-2.5
25.0	-1.9	-1.4	-1.8	-1.9	-1.9
30.0	-1.9	-1.4	-1.6	-1.8	-1.6
35.0	-1.9	-0.1	-1.1	-1.5	-1.2
40.0	2.2	0.2	0.0	-1.1	-0.2
45.0	2.2	0.6	0.5	-0.2	0.2
50.0	3.7	1.0	0.9	-0.1	0.9
55.0	3.7	1.3	1.1	1.6	1.4
60.0	3.7	1.6	1.5	1.7	1.7
65.0	6.4	2.0	1.8	2.5	2.0
70.0	6.4	3.1	1.9	2.9	2.5
75.0	6.4	5.0	2.5	3.4	2.9
80.0	8.3	5.0	2.7	4.3	3.6
85.0	8.3	5.6	3.5	4.8	4.4
90.0	8.3	6.7	4.3	5.3	5.0
MEAN	1.9	1.1	0.3	0.2	0.4
SD DEV	6.5	4.0	3.0	4.8	4.0
OBS	6.0	17.0	58.0	49.0	130.0

TABLE 9 SEASONAL FREQUENCY ANALYSIS OF PREDICTED MINUS OBSERVED JACKSON RIVER TEMPERATURES AT ISLAND FORD BRIDGE (RM 9.5)

Percentile	Predicted - Observed Temperature (F)				
(%)	Winter	Spring	Summer	Fall	Year
10.0	-8.0	-2.2	-5.2	-6.6	-5.6
15.0	-8.0	-2.1	-4.5	-5.1	-3.9
20.0	-8.0	-1.7	-2.5	-2.8	-2.6
25.0	-2.1	-1.7	-2.3	-2.7	-2.2
30.0	-2.1	-1.7	-1.9	-2.2	-1.9
35.0	-2.1	-0.7	-1.0	-1.9	-1.0
40.0	1.9	0.4	-0.6	-0.8	-0.7
45.0	1.9	0.8	0.3	-0.7	0.2
50.0	3.8	1.5	1.1	0.1	0.8
55.0	3.8	1.9	1.2	1.6	1.6
60.0	3.8	2.1	1.6	2.1	1.9
65.0	5.9	3.0	1.7	2.4	2.1
70.0	5.9	3.1	1.9	2.9	2.4
75.0	5.9	5.3	2.3	3.2	3.0
80.0	8.0	5.3	3.0	4.0	3.5
85.0	8.0	5.8	3.5	4.8	4.8
90.0	8.0	5.8	4.4	5.5	5.2
MEAN	1.6	1.2	0.1	-0.1	0.2
SD DEV	6.3	3.9	3.3	5.0	4.1
OBS	6.0	17.0	58.0	48.0	129.0

TABLE 10 SEASONAL FREQUENCY ANALYSIS OF PREDICTED MINUS OBSERVED JACKSON RIVER TEMPERATURES AT VALLEY RIDGE BRIDGE (RM 11.5)

Percentile	Predicted - Observed Temperature (F)				
(%)	Winter	Spring	Summer	Fall	Year
10.0	-2.7	-3.6	-4.9	-6.8	-5.1
15.0	-2.4	-3.3	-3.7	-5.5	-3.7
20.0	-1.1	-2.2	-2.8	-3.8	-2.9
25.0	-0.3	-0.8	-2.2	-2.9	-2.3
30.0	0.1	0.0	-1.8	-2.4	-1.8
35.0	0.8	0.5	-0.8	-1.9	-0.8
40.0	2.6	0.6	-0.3	-1.3	-0.3
45.0	2.6	0.8	0.3	-0.7	0.4
50.0	2.8	1.5	0.7	-0.2	0.8
55.0	2.8	2.1	1.1	1.1	1.5
60.0	3.7	2.9	1.6	2.4	1.9
65.0	4.3	3.3	1.8	2.9	2.3
70.0	5.4	3.4	2.0	3.1	2.8
75.0	6.6	3.7	2.2	4.0	3.3
80.0	8.1	4.7	2.4	5.6	3.7
85.0	10.4	5.4	3.2	6.5	4.7
90.0	11.1	5.9	3.7	7.5	5.9
MEAN	3.1	1.0	0.1	0.3	0.5
SD DEV	7.0	4.4	3.2	5.4	4.5
OBS	18.0	41.0	103.0	85.0	247.0

SUMMARY OF FISHERIES INFORMATION FOR THE JACKSON AND JAMES RIVERS

Prepared for

Westvaco Corporation
Covington, Virginia

Prepared by

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15 Loveton Circle
Sparks, Maryland 21152

October 1998R
11313.10

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1. INTRODUCTION

This report summarizes fisheries catch information for the Jackson and James Rivers in the vicinity of the Westvaco (Covington Mill) from 1989 to the present. The information is being summarized in support of an VPDES permit application for the Covington Mill and a continuation of the temperature variance of the VPDES permit. The focus of the report is a consolidation of 5 years of fisheries information collected in conjunction with fish tissue sampling efforts conducted in support of previous Covington Mill VPDES permits. The report also includes available information on gamefish assessments on the Jackson River since 1989 and some earlier fisheries data that supported the initial 316(a) demonstration for the Covington Mill.

Details relevant to the location of the EA Jackson/James Rivers sampling stations are in Section 2 of this document. EA fish collection techniques are detailed in Section 3, and a summary of the EA data is detailed in Section 4. Section 4 also includes a summary of fisheries information from other sources and a discussion of the data. References are provided in Section 5 of this report.

2. SAMPLING STATION LOCATIONS

The majority of the fisheries information for the Jackson and James Rivers in the vicinity of the Covington Mill is derived from field notes of species collected during fish tissue studies from 1989 through 1994. On behalf of Westvaco, EA developed a fish tissue sampling program for the Jackson and James Rivers in 1989. In accordance with the study plans submitted to the Virginia State Water Control Board (Botkins 1989), fish were collected from three locations on the Jackson River and two locations on the James River for most years of study. Four monitoring stations were located downstream from the Covington Mill outfall, and one control or background site was located upstream from the mill effluent. Fish were also collected from an additional James River (Eagle Rock) location in response to a request from VDH (Westvaco 1991) beginning in 1991. In the final year of the program, sampling was conducted only at the three locations immediately downstream of the plant. Detailed sampling station information is provided in Table 2-1 and Figure 2-1. Detailed maps of sampling locations are provided in the final reports (EA 1990 1991, 1991, 1992a, 1992b, 1993, 1994, and 1996) and brief descriptions of the sites are detailed below and summarized in Table 2-1. Table 2-1 also includes notes on the frequency of sampling.

Station 1, the background site, was located on the Jackson River in the vicinity of Clearwater Park, approximately 5.8 river miles (RM) upstream from the Covington Mill outfall. Monitoring Station 2 was located adjacent to the community park in Covington, approximately 0.9 RM downstream from the Covington Mill outfall (Figure 2-1). Station 3 was 14.2 RM downstream from the outfall, in the area immediately upstream from the Jackson River/Karnes Creek confluence near Low Moor. Stations 4 and 5 were located in the James River, approximately 52.3 and 86.4 RM downstream from the Covington Mill outfall, respectively. The Station 4 study reach was immediately upstream from the Horseshoe Bend boat ramp; however, a lack of sufficient numbers of designated target specimens at this location necessitated sampling at alternative locations, including as far downstream as the I-81 bridge (58.7 RM downstream of the mill) and the Route 11 bridge in Buchanan (60.6 RM downstream of the Mill). One additional reach, located in Springwood, was approximately 56.2 RM downstream from the mill outfall (Figure 2-1) and was used most often to supplement collections from Horseshoe Bend (Table 2-1). Monitoring Station 5 was in the vicinity of the railroad bridge near Snowden, approximately 86.4 RM downstream from the mill outfall, and immediately upstream from the Virginia Power Company Cushaw Hydroelectric Station and Dam. A request from VDH for additional specimens of common carp necessitated the sampling of an additional James River reach. Sampling efforts were concentrated in the reach located upstream from the Craig Creek confluence, near Eagle Rock—approximately 39.9 RM downstream from the mill outfall (Figure 2-1).

All sampling stations contained (or were contained within) pool habitats and/or depositional zones, and were separated by a minimum distance of approximately 6.7 RM. All available habitats were sampled within each study reach in an effort to collect the desired complement of fishes for tissue analysis. Brief site/habitat descriptions are provided in Table 2-1.

Fish sampling was conducted in the immediate vicinity of each location described above; however, the sample reach at each station was extended to a maximum 2.4 RM length to facilitate collection of the required number and species of fish for tissue analysis. The sample reach varied considerably by survey period at most locations except those closest to the Mill. Specific details on the length of river sampled during each survey year can be found in the EA reports (EA 1990 1991, 1991, 1992a, 1992b, 1993, 1994, and 1996).

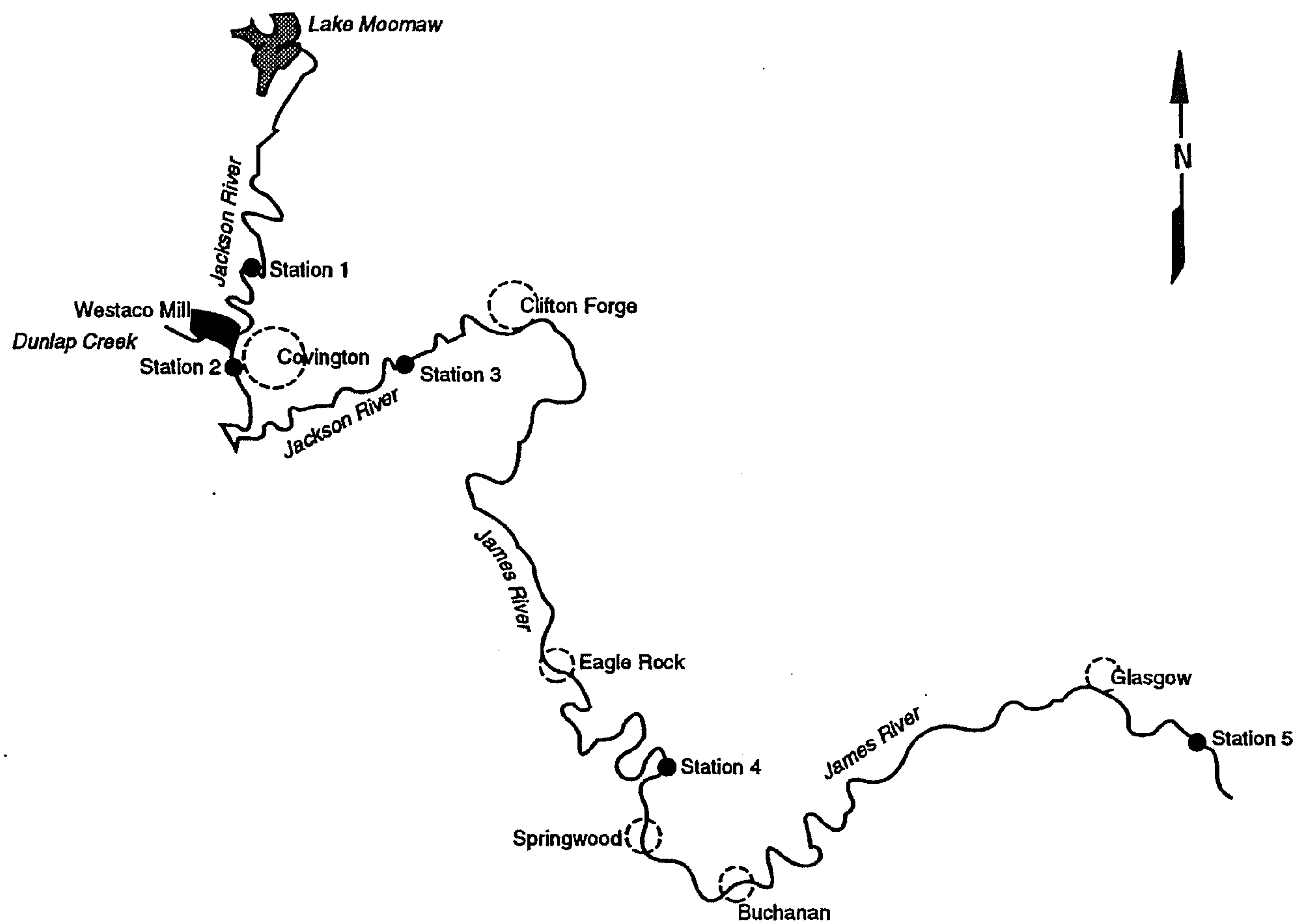

Figure 2-1. Sampling station locations on the Jackson and James Rivers.

TABLE 2-1 JACKSON RIVER AND JAMES RIVER SAMPLING STATION INFORMATION

Station Number	Distance From Outfall	Station Location	Site Description/Habitat Type	Comments
1	5.8 river miles (RM) upstream from the Covington Mill outfall	Jackson River, near Clearwater Park, in the vicinity of the Rt. 687 bridge.	Characterized by pool, riffle, and run habitats. Maximum depth approximately 6 ft. Substrate primarily cobble and boulders, some bedrock, leaf litter and fallen trees.	Sampled during all survey periods except 1994.
2	0.9 RM downstream from the Covington Mill outfall	Jackson River, near the community park (Covington) adjacent to the USGS gauging station (downstream from Dunlap Creek confluence).	Characterized by pool and run habitats. Maximum depth approximately 4 ft. Substrate primarily fines (sand/silt) and detritus with some fallen trees, boulders, and bedrock.	Sampled during all survey periods.
3	14.2 RM downstream from the Covington Mill outfall	Jackson River, immediately upstream from Karnes Creek confluence with the Jackson River near Low Moor.	Characterized by run and pool habitats. Maximum depth approximately 4 ft. Substrate primarily boulders and cobble, with some gravel, fines (sand/silt), and fallen trees.	Sampled during all survey periods.
Eagle Rock	39.9 RM downstream from the Covington Mill outfall	James River, in the vicinity of the Craig Creek-James River confluence.	Characterized by riffle, run, and pool habitats. Maximum depth approximately 6 ft. Substrate primarily cobble, with some boulders, fines (sand/silt), and fallen trees.	Sampled only during 1992, 1993 & 1994.
4	52.3 RM downstream from the Covington Mill outfall	James River, immediately upstream from the VA Dept. of Game and Inland Fisheries Horseshoe Bend Boat ramp. Figure 2-5.	Characterized by riffle, run, and pool habitats. Maximum depth approximately 6 ft. Substrate primarily cobble and boulders with some bedrock, sand, and submerged aquatic vegetation along margins.	Sampled during all survey periods except winter 1992.

TABLE 2-1 (Cont.)

Station Number	Distance From Outfall	Station Location	Site Description/Habitat Type	Comments
4 (cont.) Springwood	56.2 RM downstream from Covington Mill outfall	James River, immediately downstream from the Rt. 630 bridge in Springwood.	Characterized by run and pool habitats. Maximum depth approximately 6 ft. Substrate primarily boulders and fines (sand/silt).	Sampled during all survey periods except 1989 and 1994.
4	58.7 RM downstream from the Covington Mill	James River in the vicinity of the I-81 bridge	Characterized by run and pool habitats. Maximum depth approximately 6 feet. Substrate primarily boulders, cobble, sand, & fines.	Sampled only in winter 1992.
4	60.6 RM downstream from the Covington Mill	James River immediately upstream from the Rt. 11 bridge, in Buchanan	Characterized by run and pool habitats. Maximum depths to 4 ft. Substrate primarily cobble & gravel with some mud & boulders.	Sampled only in 1990 and 1991.
5	86.4 RM downstream from Covington Mill outfall	James River, in the vicinity of the railroad bridge near Snowden, in the impoundment located upstream from VA Power Cushaw Hydro Station.	Characterized by pool habitat. Maximum depth sampled was approximately 8 ft. Substrate primarily fines (sand/silt/clay) and fallen trees with some boulders, cobble, and bedrock.	Sampled during all survey periods except winter 1992 and 1994.

3. DATA COLLECTION TECHNIQUES

3.1 Objectives

To understand the type of fisheries data collected as part of the tissue collection efforts, one must understand the objectives of the tissue studies. In accordance with the study plan details submitted to the Virginia State Water Control Board in September 1989 (Botkins 1989), the original goal of the fish tissue collections (EA 1990 and 1991) was to collect four composite samples at each of the stations identified in Section 2. Recommendations of VDH prescribed a more intensive sampling effort ultimately resulting in the collection of six composite samples at each station in 1991 and 1992. As a result, the objectives of the 1993 study returned to those identified for the base monitoring program (EA 1990 and 1991), in that only four composites were collected per station. In 1994, the study objectives were further reduced to include only the three stations immediately downstream of the mill and a reduced number of samples which included only bottom feeder and forage species.

Study plan details (Botkins 1989, Westvaco 1991) identified bullhead catfishes (*Ameiurus* spp.) and common carp (*Cyprinus carpio*) as the preferred target bottom feeder species. Smallmouth bass (*Micropterus dolomieu*), rock bass (*Ambloplites rupestris*), and sunfish species (*Lepomis* spp.) were the recommended target sport fish species. U.S. EPA Region IV recommendations highlighted in Botkins (1989) suggested that composited specimens should be adult fish of similar size (about 2 to 4 lbs each, or 2 to 3 years old, if obtainable). When possible, each Jackson and James river sample (composite) consisted of individuals of similar weight and length, with larger/adult specimens preferred. This type of tissue evaluation specifically targets larger fish and generally does not provide a holistic evaluation of the fish community at the site. Only once (in 1994) were forage species specifically targeted for collections and evaluation and collections that year were only made at three locations.

Although outside of the scope of the tissue collections, the type of fish collected in addition to the target species were noted as part of EA's field notes. Although some notes were made on relative abundances of species present at each site collection, no actual quantification was made and any notes on size distribution or fish condition were completely qualitative. These qualitative field observations are the basis for the EA field data summarized in this report.

3.2 Methods

Sampling was conducted by an EA Engineering, Science, and Technology crew consisting of one American Fisheries Society Certified Fisheries Scientist and one Quality Assurance/ Quality Control Officer. To standardize collections among years, most sampling was conducted in September or October. In 1991, however, collections were made in the summer (EA 1992b) with additional bottom feeder specimens collected in winter 1992 (EA 1992a). Detailed notes were recorded at each sampling station including the type of sampling gear, level of effort (time), general habitat types, sample reach length, weather conditions, fish species encountered, and selected physiochemical data. All notes were recorded on a standard EA Fisheries Record Form. In addition, *in situ* water quality measurements were taken concurrently with fisheries collections at each station. A Hydrolab Model 4041 water quality analyzer was used to measure dissolved oxygen, pH, water temperature, and conductivity at each station.

The field investigators were equipped with an array of fisheries collection gear which enabled sampling of all habitats (at each station) under a variety of river conditions. The U.S. EPA recommended active methods of fish collection in their Sampling Guidance Manual (Versar 1984), such as electrofishing, trawling, angling, or seining. These methods are preferred rather than passive methods (e.g., gill nets, trap nets, trot lines) because the collection period is typically shorter (i.e., hours versus days) thereby minimizing decomposition, and because samples are collected from much more definable areas (Versar 1984). Electrofishing was the principal sampling method at all stations; however, the use of gill nets and angling was necessary in order to collect the number and species of bottom feeders needed for analysis. A boat or pram equipped with a Coffelt VVP-2C electrofishing unit (pulsed direct current), powered by a 120-volt generator, was used to sample fish within each study reach. Electrofishing techniques followed those described in the National Dioxin Study (Versar 1984). All of the techniques utilized target larger individuals.

Fish collection techniques and level of effort (time) expended at each of sampling locations varied considerably among stations and years. Because the nature of the data summarized herein is qualitative, no attempt has been made to summarize the collection efforts for the five year period. In general, less effort was necessary at the stations in the Jackson River because the river is narrower and shallower than the areas of the James targeted for this study. Electrofishing was, therefore, more effective in the Jackson River. In terms of the overall electrofishing effort needed to collect the requisite numbers of target species within the Jackson River, Stations 2 and 3 (immediately downstream of the Covington Mill) required the least amount of sampling effort during all survey periods. Trotlining, angling, and gillnetting was generally only necessary at stations 4 and 5 (in the James River) and occasionally at the control station (Station 1) in the Jackson River. This observation implies that the abundances of target species in the Jackson River immediately downstream of the Covington Mill were relatively high and stable throughout the tissue monitoring period (1989-1994).

4. RESULTS AND CONCLUSIONS

4.1 Results

The fish community information that was included in the tissue collection field notes was best summarized as a list of species observed at each site. Because the collections were not standardized or comprehensive for community assessment, comparisons of observations among years was avoided. Instead, all species observed at each location over the five year period were summarized by station in Table 4-1. The several locations that constitutes Station 4 were summarized together because of their geographic similarity relative to the Covington Mill.

Although few conclusions can be drawn from such a summary, several patterns are apparent. Station 1 is the only station within the Mill study reach that supports a coldwater fishery (as indicated by the presence of trout). Trout were noted at this location even before the Gathright Dam began cold water releases in early 1990, but seemed to increase in abundance throughout the period. At all locations (other than Station 1), the dominant gamefish were warmwater species (sunfish and bass). Rock bass, smallmouth bass, and redbreast sunfish were ubiquitous in the study reach which is typical of mountain rivers in this region. Although tolerant species such as common carp and white sucker were collected at most stations, pollutant intolerant species such as northern hogsucker were found both upstream and downstream of the Covington Mill. These are important observations with respect to the thermal variance for the Covington Mill. The Resident Important Species (RIS) identified in the 316 (a) thermal study (EIA 1979) were white sucker, rock bass, redbreast sunfish, smallmouth bass, and johnny darter. All RIS, except johnny darter, were collected in abundance below the Covington Mill outfall during the five year tissue monitoring period. The absence of johnny darter from the tissue collections would be expected because the sampling gear is biased for larger individuals and darter habitat was not targeted for tissue collections.

Due to the sampling biases, the number of shiner/minnow and riffle species (e.g. darters) observed is relatively low but this bias would apply equally to all stations. It should be noted that observations made at Eagle Rock were not as comprehensive as at other locations because the station was not sampled as frequently as other sites and only common carp were targeted, thus further biasing the observations. Fish health and condition is also difficult to gauge from general observations. All fish that were kept for tissue analysis were in good health and condition and no notes were found indicating that fish in poor condition were observed at any location.

Some other inferences (that would not be apparent from a species summary) can be made from the field notes. In general, the number of species observed at each station appeared to increase as tissue sampling objectives changed through the study period. Although this maybe be attributed to increased sampling efforts in 1992 and 1993, improvements in water quality in the basin through the study period could also have contributed. One other trend that was clear from the observations is that the families that dominated the community at each location throughout the study period were relatively stable. For example, Stations 2 and 3 are dominated by young sunfish species while Stations 4 and 5 are dominated by minnow species and these trends were noted each year.

One final inference from the EA fish observations. Excluding Eagle Rock (for the reasons previously stated), the number of species noted throughout the study period was relatively similar among all stations (except Station 3). Without quantifying the various species and habitat evaluations, specific conclusions about fish community health and balance are not possible. However, the number and type of species observed at most locations and the apparent stability of the dominant groups implies that a relatively healthy fish community probably exists at most locations.

The only available previous study within the reach that quantified the fish community was conducted in 1973 (Mohn 1973). Comparisons between the 1989-94 observations and the previous data are difficult due to the nature of the recent data and the changes that have been made in the system. The Gathright Dam (upstream of the Covington Mill) went into operation in the early 1980's and began cold water releases in 1990. These two significant changes in the Jackson River have probably changed river conditions throughout the reach, but particularly in the stretches upstream of the Covington Mill. Data from 1973 tend to corroborate this assertion. Data from two stations, one 10 miles upstream of the mill and one 15 miles downstream of the mill were presented in an Energy Impact Associated Report (EIA 1979). Based upon the species present, the area above the Covington Mill supported a warmwater fishery in the 1970's. The sunfish and catfish species collected above and below the mill at that time are very similar to those found at most locations downstream of the mill from 1989-1994. Therefore, the minnow and riffle species collected during 1973 are probably a good indication of the species that are found downstream of the mill today. Collections included 16 minnow species, one sculpin, and two darter species and all were typical of mountain rivers in the region.

More recent surveys of the Jackson River have been conducted in 1997 in the vicinity of Gathright Dam to assess the trout and other game fish populations and confirm that the forage base is sufficient to support both the wild and stocked populations of trout in the river (VDGIF 1997). In addition, the data from this study suggests that the further downstream from the dam release prior to influence by Westvaco's outfalls, the fish population starts to revert back to the original warm water fishery with more Centrachids species being observed. However, most of the work was conducted too far afield to be pertinent to evaluations of the fish community in the vicinity of the Covington Mill. The data does show that there is a sufficient forage base to support trout and that little increase in the populations of most forage species have occurred since coldwater releases have begun (VDGIF 1997). Although survival of stocked trout are fair, little wild reproduction is probably occurring. The coldwater releases have served to decrease the populations of redbreast sunfish and smallmouth bass in the tailrace, which was expected (VDGIF 1997). The VDGIF reports indicate that fish communities in the Jackson River upstream of the mill appear to be relatively diverse and balanced and, with a few exceptions, most populations are relatively stable (VDGIF 1997).

4.2 Conclusions

The EA fish observations, considered in the context of the historical data from the site and the recent data from upstream support several conclusions:

- Fish communities within the Jackson River in the vicinity of the mill appear to be stable and of relatively high diversity.
- Many of the species observed in 1973 upstream and in the vicinity of the mill have been collected more recently (EA collections during the 1990s). Community structure downstream of the mill appears to be very similar to the historical fish community structure.
- Observations during EA field sampling seemed to indicate that diversities were stable and perhaps even increasing in the tissue monitoring reach.
- The fish identified as Resident Important Species (RIS) for the thermal variance were also the target species for the tissue monitoring work. These species were most abundant at the stations immediately downstream of the mill and abundances were high enough and stable enough to support the five year tissue monitoring program.
- Coldwater releases from Gathright dam have altered the fish community upstream of the Covington Mill but the fish community appears to be heathy and stable and the

further downstream of the dam, prior to Westvaco's outfalls appears to be reverting back to the historical warmwater fishery.

Without contemporary quantitative fisheries data, it is impossible to make any definitive conclusions about the current state of the fish communities in the Jackson and James Rivers. The available information does support the overall conclusion that the Covington Mill discharges do not appear to be precluding maintenance of a balanced indigenous fish community in the Jackson River and adjacent areas of the James River.

TABLE 4-1 FISH SPECIES COLLECTED DURING TISSUE SAMPLING IN THE JACKSON AND JAMES RIVERS, 1989-1994.

	Station					
Species	1	2	3	4(a)	5	Eagle Rock
Bluntnose minnow		✓				
Mimic shiner		✓				
Cutlips minnow	✓					
Creek chubsucker	✓	✓	✓	✓		
Golden shiner	✓	✓		✓		
River chub		✓				
Central stoneroller	✓			✓	✓	
Common carp		✓	✓		✓	✓
Fallfish	✓	✓	✓		✓	
Shiner/minnow spp.	✓	✓		✓	✓	
Goldfish			✓			
Black jumprock	✓	✓	✓	✓		
Shorthead redhorse				✓	✓	
Redhorse suckers					✓	
Northern hog sucker	✓	✓		✓		
Quillback				✓	✓	
White sucker	✓	✓	✓	✓		
Yellow bullhead	✓	✓	✓	✓	✓	
Brown bullhead	✓	✓		✓		✓
White catfish		✓	✓			
Channel catfish				✓	✓	
Flathead catfish				✓	✓	✓
Madtom sp.				✓	✓	
Rainbow trout	✓					
Brown trout	✓					
Chain pickerel	✓	✓				
Muskellunge				✓	✓	
Rock bass	✓	✓	✓	✓	✓	✓
Redbreat sunfish	✓	✓	✓	✓	✓	
Warmouth		✓			✓	
Black crappie		✓				
Bluegill	✓	✓	✓	✓	✓	
Pumpkinseed		✓	✓	✓		
Green sunfish			✓			
Misc. Juv. Sunfish			✓		✓	
Largemouth bass		✓	✓	✓	✓	
Smallmouth bass	✓	✓	✓	✓	✓	
Roanoke darter				✓		✓
Sculpin sp.	✓					
Total Taxa	19	23	16	22	19	5

(a) Includes collections at all areas designated as Station 4: 52.3 RM, 56.2 RM (Springwood), 58.7 RM; and 60.6 RM downstream of the Covington Mill.
Note: Species in bold are Resident Important Species identified in previous thermal studies of the Covington Mill.

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FIRST ANNUAL REPORT

to

STATE WATER CONTROL BOARD

April 25, 1972

INTRODUCTION AND SUMMARY

In April, 1971, Westvaco presented to the Board a program for the development and installation of an effluent color removal system. This system would permit the achievement of stream standards in the Jackson River below Westvaco's Covington Mill. The Board directed Westvaco to proceed with its program, to accelerate its activities where possible, and to keep the Staff advised of activities and report progress to the Board in twelve months.

These directives have been complied with and the target dates on the program integration report submitted to the Board have been achieved. The results of our efforts, particularly the two major items on the schedule -- the comprehensive mill flow balance and the lime-carbon bench scale color removal studies -- are described in more detail in the following sections.

Preliminary evaluations of the lime-carbon study indicated several potentially serious drawbacks in this approach to the complex situation at the Covington Mill. Accordingly, we accelerated our efforts by incorporating the concept of color reduction via oxygen bleaching and the recycling of bleach room filtrate to the chemical recovery system. This concept holds promise as a more feasible approach to color removal at Covington.

Our future plans are outlined on the attached program integration chart, which has been expanded to include our oxygen bleaching work. Through parallel studies on a very demanding schedule, we plan to reach a decision by March, 1973, as to whether the Covington Mill should proceed with color removal via the lime-carbon approach or the oxygen bleaching approach. Should oxygen bleaching be the chosen technique, and no major pitfalls are encountered, we anticipate a 50% color reduction by May, 1976 -- eighteen months before the date originally suggested for color removal via a lime-carbon system. Complete color reduction would follow, after evaluation on the original commercial scale equipment, with a second full bleach line installation.

We request the Board's continuing approval for our color removal program.

Jackson River Background Color – 5 color Plant Eff – 24 mgd
Plant Present Color – 1800 color
Plant @ 50% Reduction – 900 color

	Flow: Drought (7 days – 10 yr) (cfs)	(mgd)	Flow: Gathright Guarantee (mgd)	Average (mgd)
Jackson River at Falling Spring –	66	42	104	325
Color @ Present		650	340	130
" @ 50% Reduction		330	170	65
James River at Lick Run –	185	112	174	1000
Color @ Present		320	202	46
Color @ 50% Reduction		160	100	23
James River at Buchanan –	277	180	242	1550
Color @ Present		215	166	
Color @ 50% Reduction		110	83	
James River at Holcomb Rock –	375	240	302	2200
Color @ Present		170	136	
Color @ 50% Reduction		85	68	
James River at Bent Creek –	470	300	362	2700
Color @ Present		140	116	
Color @ 50% Reduction		70	58	
James River at Scottsville –	510	330		
Color @ Present		125		
Color @ 50% Reduction		60		

THE EFFECTS OF COLOR AND SOLIDS ON THE DEPTH OF COMPENSATION AND PRIMARY PRODUCTIVITY IN THE JACKSON RIVER, VIRGINIA

Prepared for:

Westvaco Corporation
Covington, Virginia

Prepared by:

EA Mid-Atlantic Regional Operations
EA Engineering, Science, and Technology, Inc.
Sparks, Maryland

April 1990

EA Report 11258.01

TABLE 3-9 EFFLUENT AND AMBIENT RIVER WATER ANALYTICAL RESULTS

Parameter (units)	Whole Effluent	Sample Station # 1	Sample Station # 2	Sample Station # 3
Apparent Color (color units)	875	10	100	70
True Color (color units)	750	10	100	70
Total Solids (mg/L)	2588	93	370	310
Total Suspended Solids (mg/L)	38.4	<5	<5	<5
Settleable Solids (mg/L)	<5 (6.4)	<5	<5 (0.85)	<5 (0.60)
Non-Settleable Suspended Solids (mg/L)	(3.2)		(4.3)	(3.0)

NOTE: ( ) = estimated value

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UPDATE OF THE JACKSON RIVER DISSOLVED OXYGEN MODEL

WEST0080

Prepared by:

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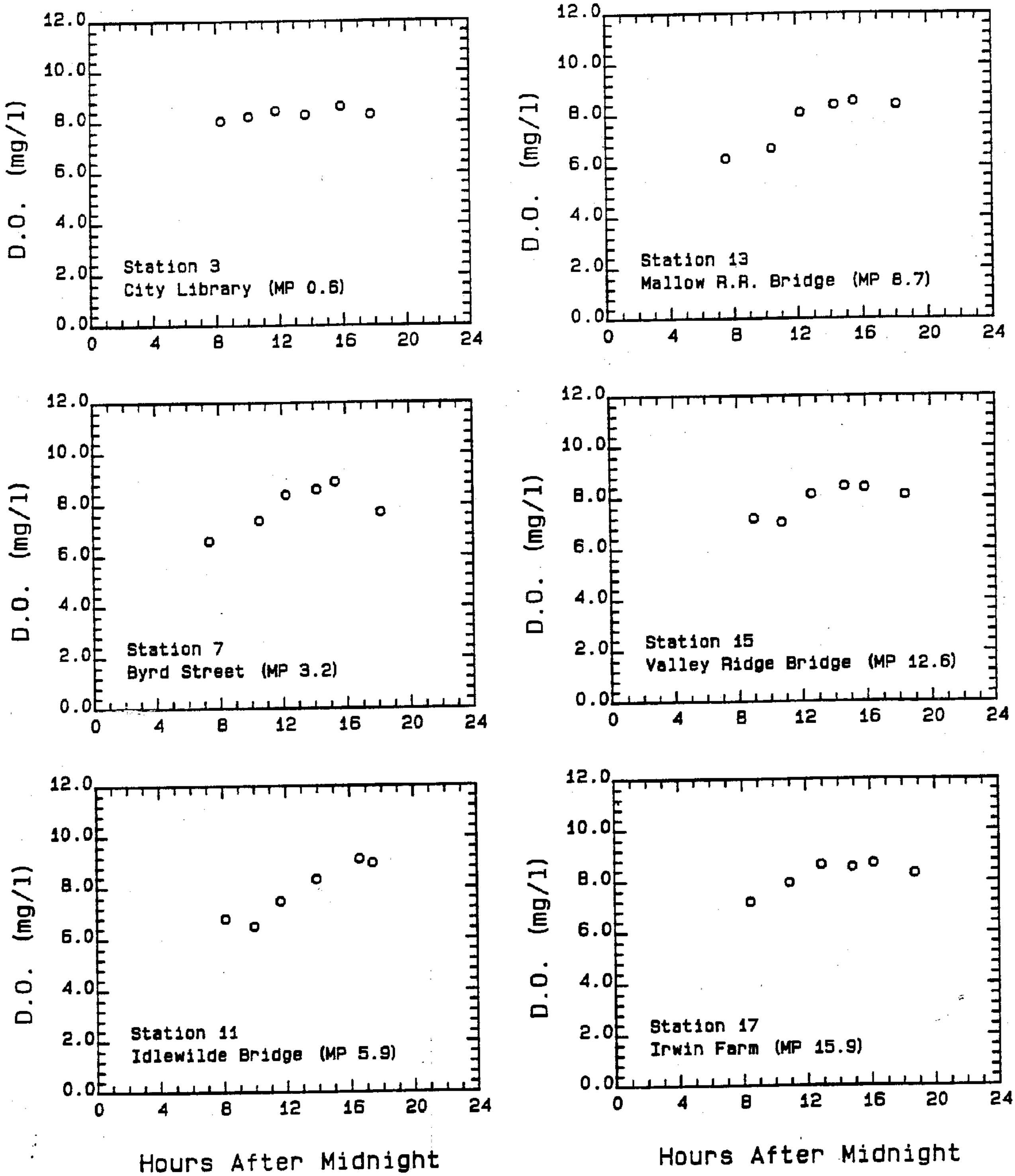
May 24, 1991



Jackson River Diurnal Dissolved
Oxygen Profiles for June 27, 1990

FIGURE 5.